

February 1989/\$2.00

# Mobile Radio Technology

The Journal of mobile communications technology

Fiber optic cable, p. 8

Charging nicad batteries  
Frequency coordination

AN INSTANT PUBLICATION





# Base station antennas: A lot of blue sky thinking helped us to develop some very down-to-earth solutions.

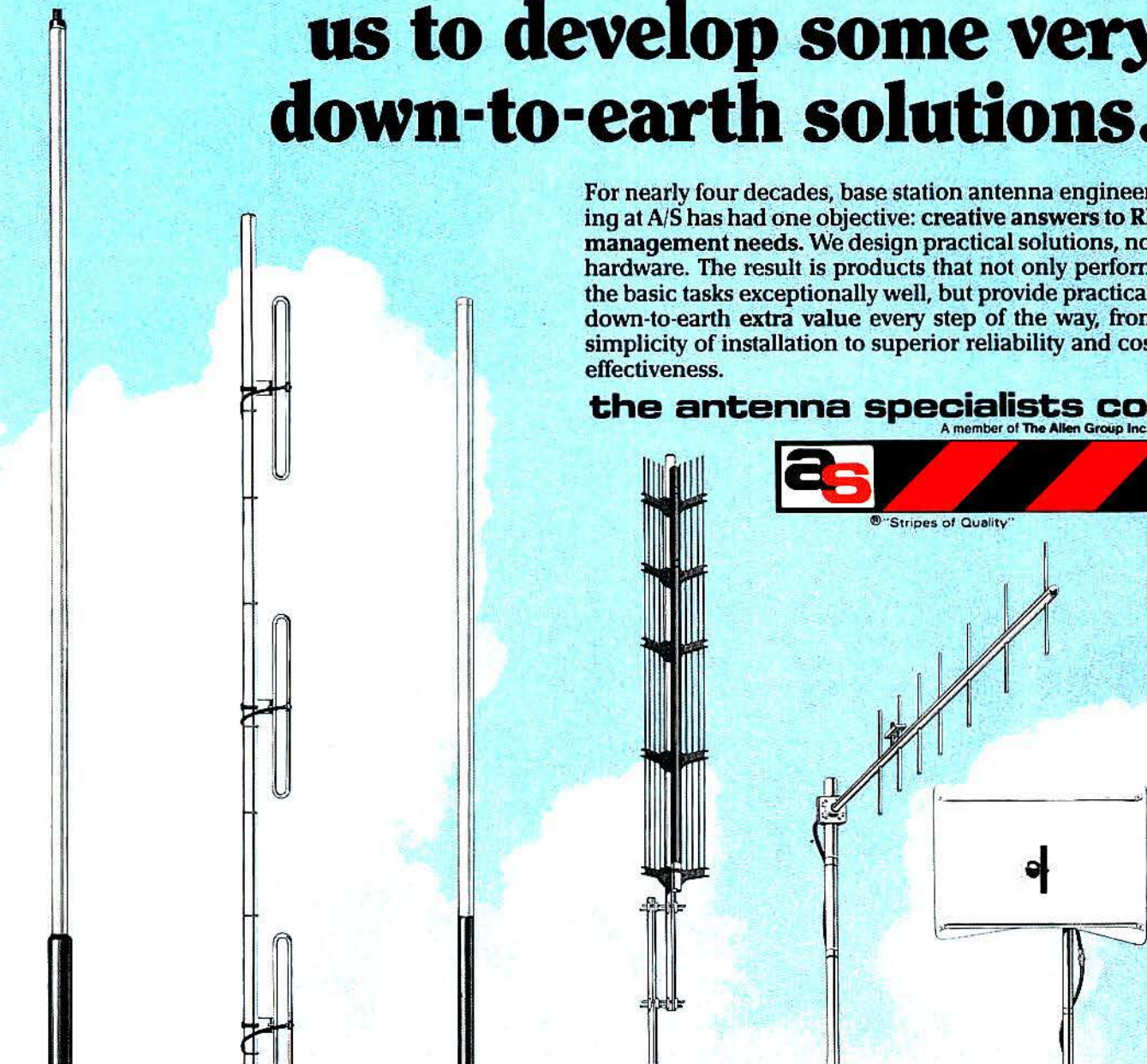
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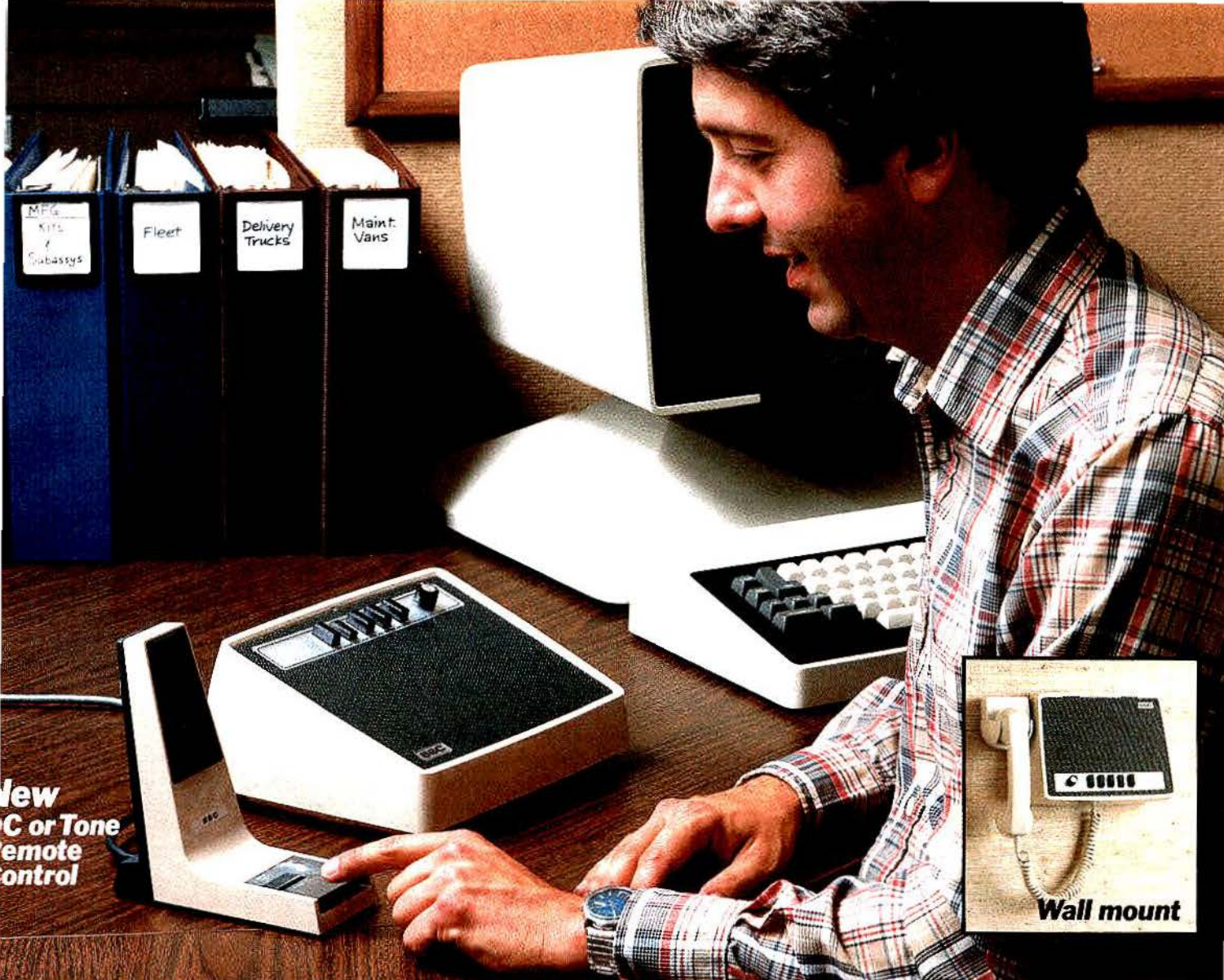


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**On the cover:** Optical fiber finds applications in radio communication. See articles on pages 8, 12 and 18. Photo courtesy of AT&T.

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## Radio Club of America: Good for the industry, good for readers



*Some of the best material MRT presents our readers comes from Radio Club of America members. They do not have a monopoly on good information, but many of them are eager to share their ideas with our readers.*

*The organization recognizes its members whose accomplishments are noteworthy by electing them to senior membership or to the grade of Fellow. In MRT, Radio Club Fellows sometimes turn out in numbers: Three, Dr. Gregory M. Stone, Dr. William C.Y. Lee and R. James Evans, contributed to a single issue, May 1988.*

*We like to support and encourage the Radio Club; its efforts are good for the industry and its members' contributions to the magazine are good for our readers.*

*In November, at its annual awards banquet, the Radio Club recognized members elected to the grade of Fellow during 1988. Their names appear on pages 40 and 42 of the October 1988 issue. Among them was editorial director Don Bishop, who delivered this response on behalf of the new Fellows:*

*It is a delight to respond on behalf of the 35 members elected to the Grade of Fellow in 1988. To be recognized by the Radio Club is to be recognized by "the world's first communications society," as it is often called.*

*The club was organized for the interchange of knowledge of the radio art, for the promotion of good fellowship among its members and for the advancement of public interest in radio.*

Our club president, Fred Link, has observed that "almost every important personage in the history of radio communications was or is a member of the Radio Club of America."

### Industry's 'leading lights'

In 1984, the club's Diamond Jubilee year, charter member and president emeritus W.E.D. Stokes Jr. said that what began as a "small body of amateur radio enthusiasts has gradually changed to a large scientific organization of recognized standing, before which the leading lights of the radio world are glad to deliver papers."

Members of the board of directors, by giving us the grade of Fellow, you have given us new recognition before a distinguished society, and we are at once humble and proud for the honor.

What president emeritus Stokes said about the Radio Club's standing remains true, as evidenced by the presentation this afternoon of five papers on broadcasting, commercial communications and amateur radio.

Interest in amateur radio led the founding members to start the club. Roughly half of the current members hold amateur licenses, as do a third of the new Fellows and half of those receiving medals, awards and citations tonight. For many of us, early interest in amateur radio started us on our career paths.

### 'Earth to Brooklyn...'

That was true for me. I remember my first night as a freshly licensed, junior-high-school-aged amateur. Using a telegraph key, I called out: *dahdidahdit dahdidahdit*.

That is Morse Code for, "Can anyone hear me?" Someone did. An amateur in Brooklyn, NY, answered. From the vantage point of tonight's banquet in the New York Athletic Club, reaching someone in Brooklyn may not seem like much. But for a junior high school student in Boulder, CO, it was like reaching another planet! In fact, were it not for the universal language of Morse Code, we might not have understood one another!

What a thrill it was. It was fascinating. For many of us among the newly

designated Fellows, an early fascination with radio brought us into radio communications and radio and television broadcasting, among other pursuits. We are the radio *fascinationists*!

Many of the newly designated Fellows are here tonight. They have distinguished themselves in the military, public or commercial sectors. After receiving the grade of Fellow, where do they go from here?

For some, becoming a Radio Club Fellow is the capstone of a career.

For others, it is a spotlight that directs attention to individuals with promising futures. They will find new opportunities for personal and career growth, thanks to the recognition given them by the board.

### Greater accomplishments or...

Where one group of previously designated Fellows went was easy to find out; I checked the addresses in the membership directory. A third of those who were designated Fellows before 1960 went to live in New Jersey.

The message to new Fellows who continue in their careers is clear: Go on to greater accomplishments, or go to New Jersey.

With deference to club president Link and vice president Mal Gurian, among others, fairness requires me to say that it clearly is possible to go on to greater accomplishments and live in New Jersey.

Wherever they go from here, you can rely on the new Fellows to go on to greater accomplishments.

On behalf of the new Fellows, thank you for favoring us with the grade of Fellow of the Radio Club of America.



# PRIVACY

Volume 1, No. 4

NEWS  
from  
transcript

## NEW TECHNOLOGY FOR TODAY'S RADIOS

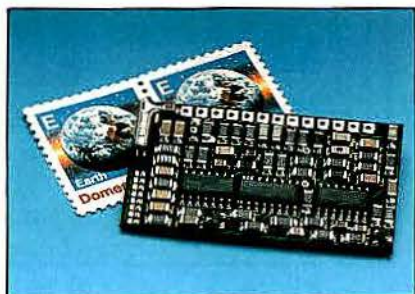
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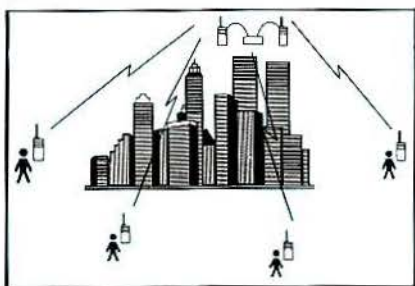
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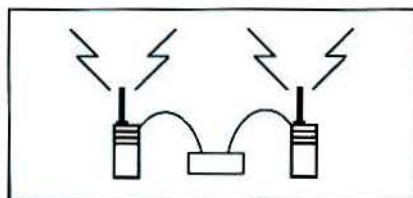
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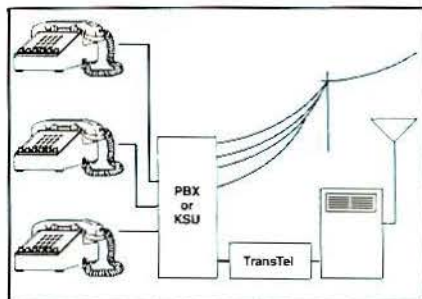
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I was surprised to read the editorial in the August 1988 issue. Although it is easy to understand, it presents several major problems to a healthy free-enterprise system.

The American system of open and equal competition does have its downside, if you are not the inventor or developer of a good idea. The system does, however, promote considerable effort on the part of individuals, as well as corporations, because they know that their efforts will be protected by our patent and copyright laws.

I would doubt that the FCC would promote concepts such as "Open Architecture for Public Safety Radio" proposed, for several reasons:

- Take a look at the problems present with the cellular telephone systems because of an imposed standard.
- For AM stereo broadcasting, the FCC decided to allow the free marketplace to settle on a standard.

I suggest that allowing the free market system to operate unhindered by the weight to *More Government* will provide all of us the best possible future.

Mark S. Hewitt  
Fairbanks, AK

## 1989 Buyers' Guide

Data Signal has requested its name be added to the 1989 Buyers' Guide in the December 1988 issue under these categories:

Interconnect  
DTMF microphones  
Encoders-decoders  
Station identifiers

## Clarification:

Our version of a product release from Antenna Specialists, (A/S), Cleveland, published in October, needs clarification. The company's base station antenna customers can receive accurate site studies, based on information supplied by the customer, from a site management service A/S offers. The company has created two computer programs from which it can generate these studies. The actual programs are proprietary to A/S and not available for sale. When provided with appropriate site data, A/S will enter the data into the appropriate program, process the data on its computer and furnish the resulting antenna emission pattern diagram to the customer.



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The journal of mobile communications technology

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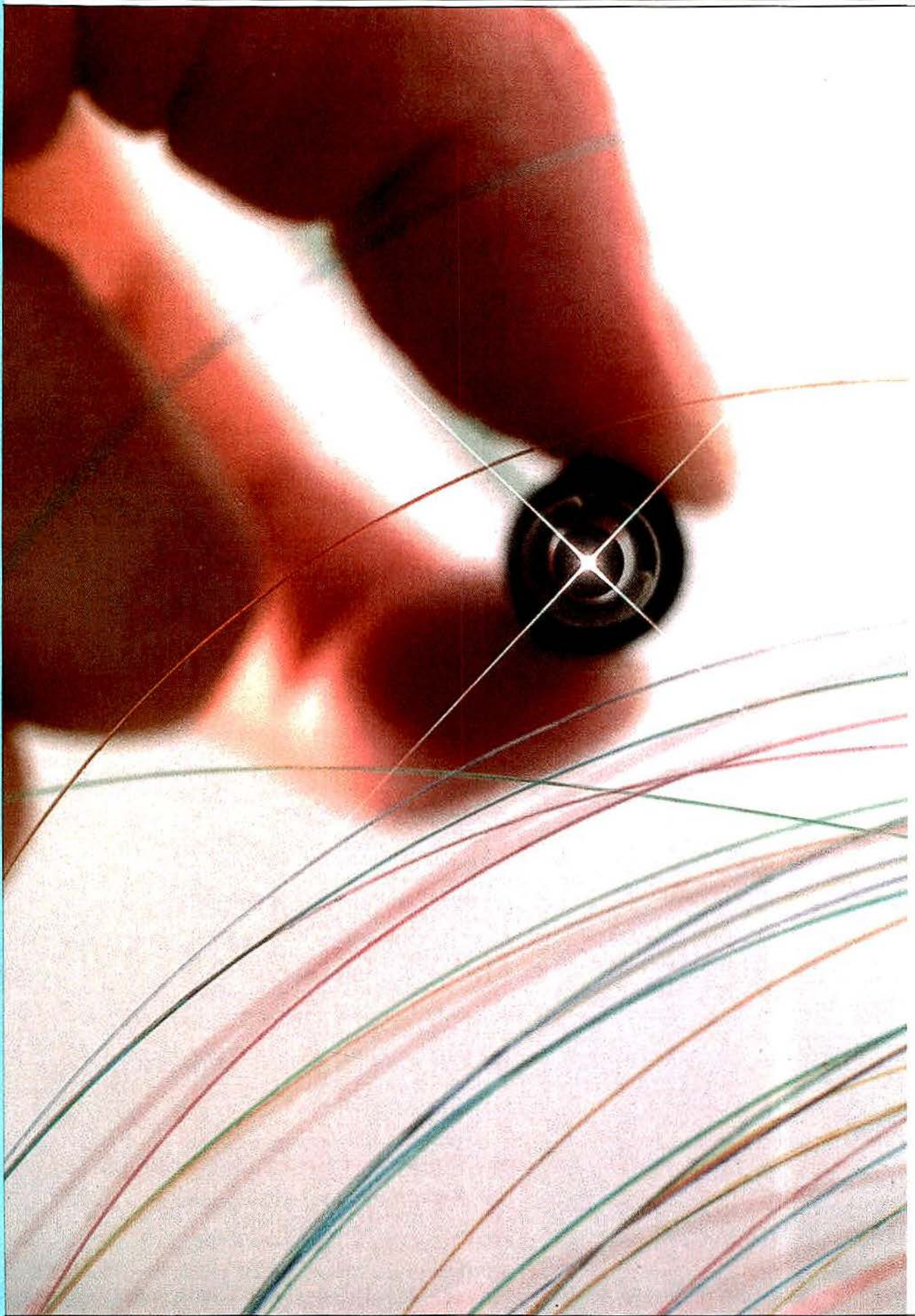
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# Replace coaxial cable with optical fiber

*Optical fiber carries single or multiple radio frequency signals as high as 1GHz. Land mobile uses include replacing coaxial cable in hard-to-fit conduits and lengthy runs. Fiber suits cellular applications, too.*

By Don Bishop  
Editorial Director

Breakthroughs in fiber optic technology allow direct analog modulation of the fiber optic transmitter's laser module at radio frequencies as high as 1GHz. That means fiber optics can replace coaxial cable in two-way radio, radiopaging and mobile telephone applications.

Communications equipment connected by fiber optic cable does not have to be placed as close to the base station antenna as it does when connected with coaxial cable because fiber optic losses are extremely low.

David L. McKay, manager of major accounts and international marketing for Decibel Products, Dallas, said the idea for the fiber optic equipment and the applications came to him during a trip to England. "I was talking with a fiber optic cable distributor," he said, "and the subject came up about applications for fiber optics in two-way radio." McKay went to work on the idea, and the result was the new fiber optic transmitter and receiver.

## Rooftop sites

One application is shown in Figure 1 at the right. With fiber optic cable used to serve a rooftop antenna site, all equipment but the high-powered transmitter may be placed many stories below, saving the cost of premium upper-story or penthouse space. Fiber optic cable carries the low-powered signal from the transmitter exciter to the high-powered amplifier.

The receiving antenna output con-

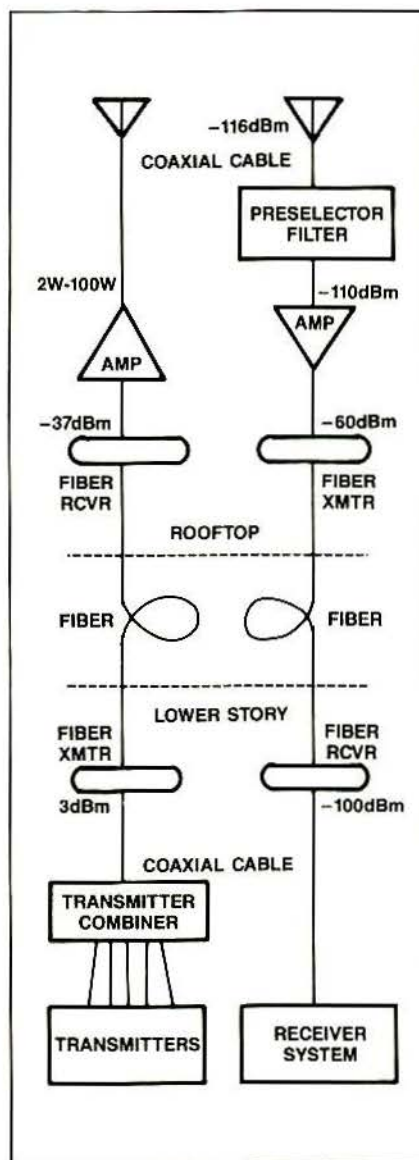


Figure 1. Fiber optic cable connects minimal rooftop apparatus with radio equipment many floors below.

nects directly or through a preselector filter and amplifier via a short coaxial line to the fiber optic transmitter. Fiber optic cable then carries signals to receiving equipment on a lower floor.

The preselector filters unwanted signals to prevent them from being amplified.

Signals delivered by the antenna to the amplifier usually fall into the -116dBm to -60dBm range. The signals may exceed that level when high-powered mobiles transmit from positions near the receiving antenna. If the signals are likely to exceed -60dBm, then some redistribution of gain throughout the system would be required to prevent overdrive and distortion.

A second example: Multiple drop points may be served by fiber optic cable. That means tunnels, subways, large buildings, ships and simulcast systems that use multiple transmitter or receiver sites or both can be connected with fiber optic cable instead of coaxial cable.

McKay said the most popular two-way radio application for the fiber optic equipment at this early stage of its introduction has been in trunked public safety systems.

"Systems are authorized for as much as 600W effective radiated power with an antenna 1,000 feet high," McKay explained. "It is impractical to try to deliver the 60W power to the antenna through 1,000 feet of coax. But it is practical to place 125W power amplifiers at the top of the tower and feed them with signal by fiber optic cable from exciters at ground level."

The 125W amplifiers feed combiners





A fiber optic transmitter and receiver of the kind used in land mobile radio applications.

## Fiber optic system

### ADVANTAGES:

- ☐ Extremely low loss
- ☐ Improved signal-to-noise ratio
- ☐ Immunity to electromagnetic interference
- ☐ Direct feed of desired signals controls intermodulation interference
- ☐ Low maintenance
- ☐ Lower overall system cost in large systems
- ☐ Single signal source for simulcasting

### DISADVANTAGES:

- ☐ Requires easements to cross public rights-of-way or for hanging on utility poles
- ☐ High cost for smaller systems

with 3dB loss, resulting in 60W to the antenna.

What makes these fiber optic applications possible is a fiber optic transmitter (modulator) that modulates radio frequencies (RF) onto lightwaves without distortion. The distortion-free characteristic resembles, in a sense, Class A amplification because the modulation characteristic is so linear.

Conversely, the fiber optic receiver (demodulator) demodulates RF from the lightwave, converting light into RF.

The fiber optic transmitters and receivers function at frequencies as high as 1GHz. The frequency range includes all land mobile radio bands.

Using fiber optic cable is attractive because of:

- **Low loss**—Single-mode fiber used

for the purpose has a light intensity loss of 0.4dB per kilometer, which is equivalent to an electrical RF loss of 0.8dB per kilometer (about 3,300 feet). By comparison, extremely low loss coaxial cable has a much higher loss. For example, 3-inch air-dielectric coaxial cable exceeds 1dB loss for lengths much beyond 200 feet at frequencies approaching 1GHz.

- **Small size**—Jacketed fibers may be as thin as 0.2-inch diameter for a single fiber. Not only can long lengths of fiber optic cables be used with little loss, they can be installed more easily in restrictive conduits than large-diameter coaxial cable.

### Simulcasting

Simulcast systems use multiple transmitters, simultaneously broadcasting on the same frequency, to cover a wide area. Conventional simulcast techniques require close control of transmitter frequency and deviation, and audio amplitude and phase.

Using a single exciter to feed power amplifiers at the remote sites via fiber optic cable fits many of the simulcast requirements simply. The exciter's single frequency source:

(1) keeps radio frequencies and transmitter deviation at all sites exactly the same.

(2) keeps audio amplitude and phase equal at all sites.

Areas where simulcast signals from different sites overlap are subject to distorted reception. With fiber optic distribution, overlap areas can be held to a minimum and can be confined to low traffic density. Control of overlap areas is achieved by a combination of changes in antenna elevation and signal emission pattern, and by taking advantage of terrain features.

Fiber optics offer solutions for difficult installations, the high cost of rooftop equipment space, distribution of signals to multiple sites and simulcasting.



### Additional reading

Salato, Steve, "Fiber Optics Link Dispatch With Repeater Microwave System," *Mobile Radio Technology*, December 1985.





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# Fiber optics serve mobile radio systems

*Fiber optic cable expands the range of alternatives available to mobile radio system designers. As costs drop, designers call on fiber optics to solve interference, noise and conduit space limitations.*

By Roald Steen

Many areas of the communications industry have undergone a quiet revolution led by fiber optic cable. Presently, installers place more of these cables than they do copper cables for such applications as connecting telephone company switching centers.

Although little use has been made of fiber optic cable in mobile radio systems, the technology offers advantages over copper cable:

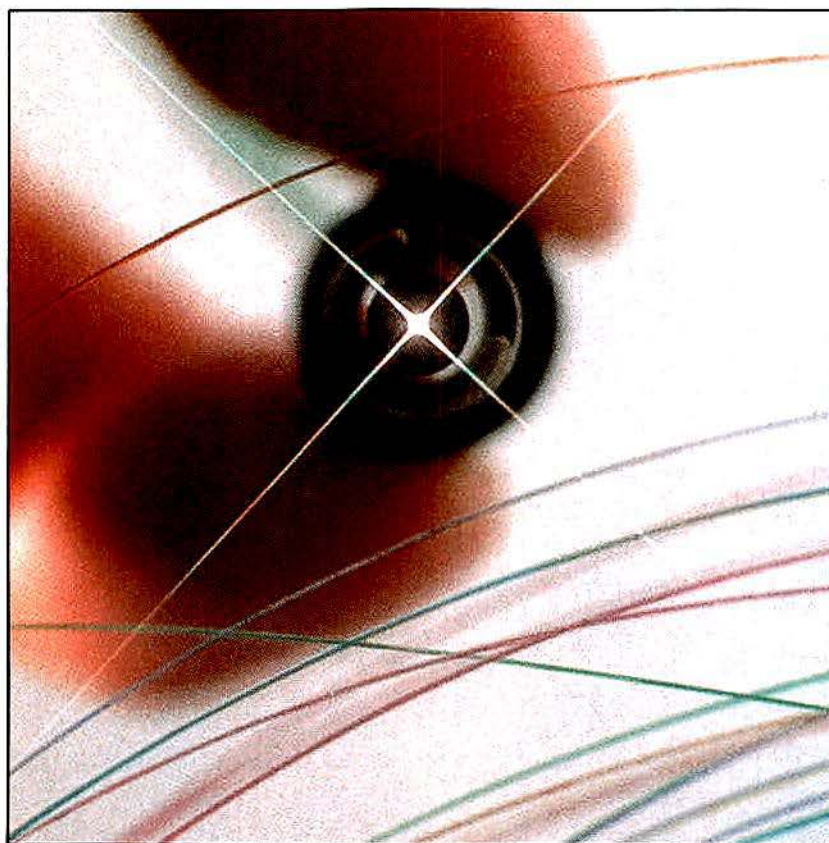
- immunity to electronic and radio noise.
- low attenuation.
- small cross-sectional area.

The main obstacle has been cost, but the cost of the cable and connectors is dropping. In some applications, it already is competitive with copper, twisted-pair cable.

Most fiber optic communications systems use digital modulation. Information is transmitted as pulses of light.

Some systems use analog modulation,

Steen is an electronics instructor and free-lance writer. He has worked as a two-way radio technician, and he lives in Woodbury, MN.



which may work better than digital modulation in some applications.

Fiber optic cable can be used:

- (1) to connect a dispatch location to the base station or to repeaters.
- (2) to connect repeaters, satellite receivers and voting systems.
- (3) to control repeater and transmitter sites.

Many of these environments, which suffer from high levels of electronic and radio noise, could benefit from fiber optic cable's immunity to such

interference.

Fiber optic cable comes in various configurations. Always, the fiber forms a small part of the cable. The bulk of the cable is made of material intended to protect the thin fibers. Some cables come with a pair of copper wires that can be used to supply power to optical receivers, transmitters or repeaters.

• *Plastic fibers—*

The cheapest cable is made from plastic fibers. Plastic fiber cable offers the advantage of easy installation because its diameter is large. The disadvantage is that the cable has a limited range. It can be used only in short lengths that

cover distances of a few hundred feet or less. This restricts the use of plastic fiber optic cable to systems contained within buildings or clusters of buildings.

• *Multimode glass fiber—*The first type of glass fiber that was developed is multimode fiber. It is made from glass whose composition resembles the glass used in windows and windshields. Multimode fiber spans distances of several miles. Its information-handling capacity is limited because different components of the light pulse use different



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### **Fiber optic cable can be used:**

- (1) to connect a dispatch location to the base station or to repeaters.**
- (2) to connect repeaters, satellite receivers and voting systems.**
- (3) to control repeater and transmitter sites.**

paths during their journey from one end of the fiber to the other.

Portions of a pulse subjected to reflections from the fiber's coating travel a longer path than portions of the pulse that travel the center of the fiber. The time differential between arrival times of the various portions of the light pulse is small. Nevertheless, the differential poses a serious problem in data communications circuits that must handle millions of pulses per second.

The differential "smears" light pulses traveling through multimode fiber, limiting capacity. Smearing increases with fiber length and the pulse rate.

- **Single-mode fiber**—The newest and highest capacity optical fiber is single-mode fiber. It is manufactured with a variable refractive index across the fiber diameter. The manufacturing process forms the variable refractive index in such a way that the portion of a light pulse moving through the fiber center travels more slowly than portions of the pulse moving near the edge of the fiber.

The complicated construction causes all portions of a pulse to arrive at the receiving end at virtually the same time. Thus, data communications circuits that must work at extremely high speeds and over long distances use single-mode fiber.

A light pulse sent through a single-mode fiber may travel 50 miles without too much attenuation for the optical receiver. Range can be extended with repeaters. For example, a fiber optic cable that will span the Atlantic is expected to be installed this year. Numerous repeaters will allow light pulses to reach from one end of the cable to the other. The cable will have more capacity than any copper transatlantic cable.

For the relatively low communications capacities needed by fiber optic circuits in mobile radio service, multi-

mode fiber is likely to be suitable. Multimode fiber also works well with analog fiber optic systems.

#### **Connectors**

Until a few years ago, low-loss fiber optic cable connectors that install quickly were not readily available. But several manufacturers presently make satisfactory connectors.

Early connectors suffered from losses

### **Cable configurations**

**Fiber optic cable comes in various configurations:**

- ☐ **Plastic fibers**
- ☐ **Multimode glass fiber**
- ☐ **Single-mode fiber**

approaching 3dB per connection. Modern connectors limit losses to 0.2dB to 0.3dB. Some do not require any more skill to install than a PL-259 coaxial cable connector.

Connectors for single-mode fibers obviously are those that require the higher levels of accuracy to make sure the two mating fibers match each other in the connection. Multimode fibers are less demanding. Plastic fibers, with their large diameters, require the least advanced connector technology.

#### **Receivers, transmitters**

Much of the cost of a fiber optic system lies in the optic receivers and transmitters at each end of the cable. Competition has caused prices to fall, though. Fiber optic components are available for a few hundred dollars. One supplier has a low-capacity fiber optic

modem that sells for \$125. Another produces samples of a short-range local area network (LAN) fiber optic communications link whose receiver and transmitter cost \$40.

A fiber optic cable system that provides communications for an important service such as a police or fire department should be equipped with an uninterruptible power supply. For some important communications circuits, it may be desirable to have a backup for the optic fiber, either in the form of another optic fiber or a copper wire.

#### **Cable in buildings**

Many new office and commercial buildings are built with fiber optic cables installed. Building owners provide the cable for tenants with data communications needs. It is less expensive to install the optical fiber when the building is under construction than it is to install it in a finished building.

A commercial building develops a maze of communications wiring as tenants move in and out and as various new communications systems are installed. An old building may have hundreds or thousands of wires for telephones, intercoms and controls, along with coaxial cables to serve cable television, closed-circuit television and data communications. The complicated wiring that develops over the years represents a substantial investment.

Fiber optics may eliminate much of the wiring in commercial buildings because one or a few fiber optic cables may have the capacity to provide all of the building's communications needs. As necessary optical receivers and transmitters are added, a few optical cables can handle all the closed-circuit television systems, data communications, intercoms and telephones of a large building.

Two-way radio system operators may have an interest in fiber optic cables installed by a building's owner. They may be able to use the cables already in place to connect offices and dispatchers to base stations and repeaters.

#### **What's ahead**

Fiber optic technology is still in its infancy. New technologies under development include systems in which several optical frequencies are transmitted through a single fiber. Each optical fre-



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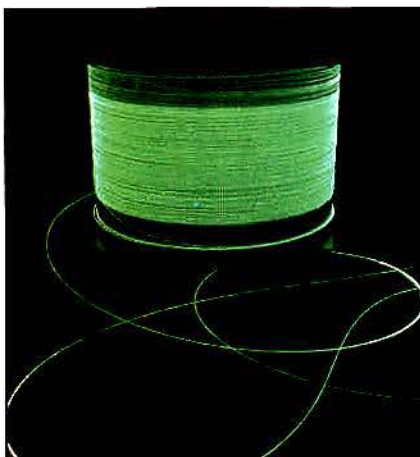
quency can operate independently of the others. The capacity of a single optical fiber thus can be multiplied.

Another promising technology lies in new glass material used in the fiber. Current glasses for single-mode and multimode fiber are made from silicon. Other materials are under investigation, including fluorides of metals. These new glass materials may yield optical fibers with such great range that oceans may be spanned without repeaters.

Test equipment available for fiber optic cable has counterparts in mobile radio. For example, there are optical power meters, optical spectrum analyzers and optical time domain reflectometers.

Copper wire in vehicles may be replaced with fiber optic cable.

Aircraft manufacturers are likely to be among the first in the transportation industry to use fiber. Many communications wires are spread throughout a modern airplane to carry out voice and communications, sensing and control functions. Copper wire increases the



**An optic fiber on a spool. The fiber itself is as thin as a human hair. Most of the volume and weight of a fiber optic cable lies in the materials that protect the fibers against the environment and mechanical stresses.**

aircraft's weight. The weight reduction made possible by fiber means less weight, more payload and more income for the aircraft operator.

A few optical fibers could replace most of the copper wiring. Various points served by copper wire instead could be served by optical fiber and a small optical transceiver module.

A simple power cable system could provide sensors, communications modules and control circuits with electrical power, in turn controlled with the help of the optical transceiver module.

Vehicle manufacturers express an interest in fiber, too, because it may simplify the vehicle wiring system. As fiber becomes part of the vehicular product, mobile radio technicians and engineers will be presented with a second reason to be interested in fiber optic technology. These emerging optical vehicular and aeronautical control and communications cable systems may be tied into the radio communications system.

Optical fibers, with their noise immunity, large communications capability and decreasing costs, soon may become a part of many mobile radio systems.



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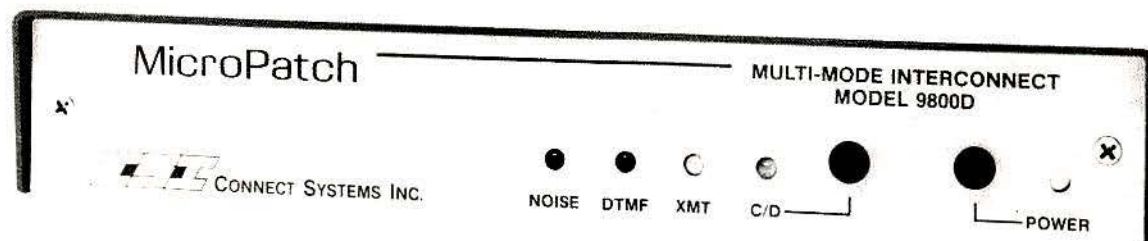
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# Fiber optics cut noise in vehicle-mounted radios

*Connecting wires can pick up engine electrical noise and reradiate it or carry it to mobile radio equipment. Increased use of fiber optic cable in vehicles holds the promise of noise reduction.*

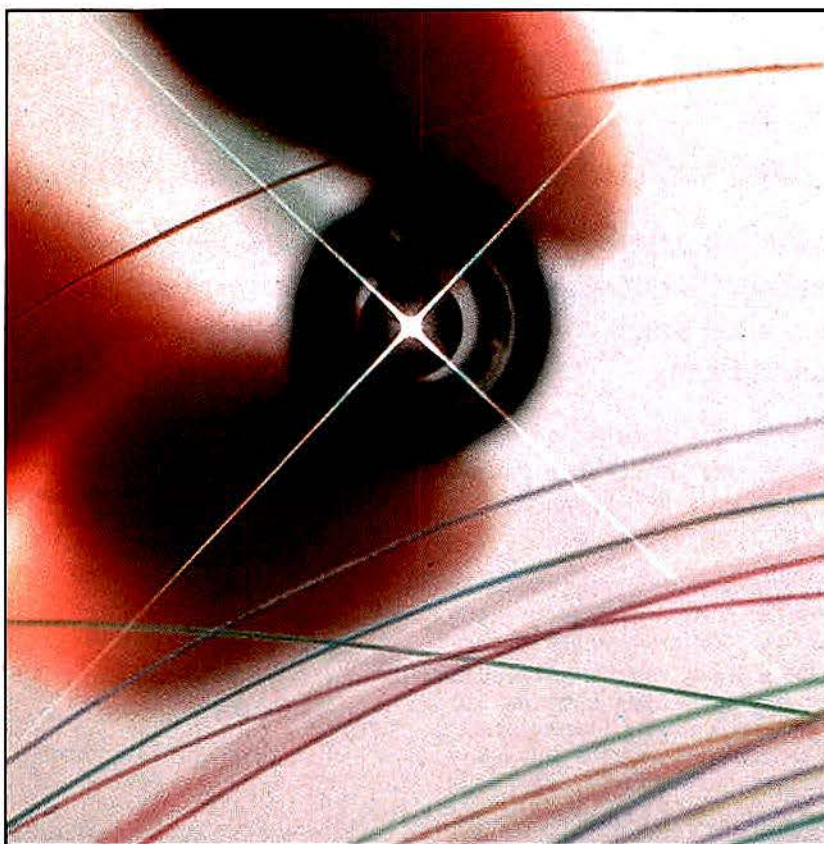
**By Don Bishop**  
Editorial Director

Electrical noise generated by vehicle engines can limit two-way radio receiver performance, reducing the effective range of system coverage. Fiber optic cable helps to prevent noise pickup to restore receiver performance. It is effective because it is non-metallic. Electrical noise can be induced into wires, but it cannot affect fiber optic cable.

Increased use of fiber optic cable can be found among two-way radio and automobile manufacturers. Its use to connect a two-way radio control head with a trunk-mount transceiver eliminates one possible route for noise to be conducted directly to the radio. Its use to control various automotive electrical devices eliminates some potential reradiation of noise that otherwise could reach the radio receiver.

## **Serial interface via fiber**

One manufacturer offers as an option a two-conductor fiber optic cable that replaces the conventional multiconductor cable between a control head and a



mobile transceiver. (See Photo 1 on page 19.)

"To make the use of a fiber optic cable possible," explained Kaspar Kasparian, president of Teletec, Raleigh, NC, "8-bit digitized audio, command and status signals from the control unit are applied in parallel to a pulse-code modulation, time-division multiplexer (PCM/TDM) to serialize the signals. At the transceiver, a reverse process deserializes the signals into parallel channels."

The transceiver communicates with the control head in the same manner.

With a conventional multiconductor control cable, connectors, sockets and wiring may have to be changed when the radio configuration is changed. With the fiber optic cable, contents of the 8-bit words are changed; the control cable remains unchanged.

"The system readily adapts itself to more complex applications," Kasparian said. He gave as an example a requirement for signals from high-speed data sources and guard receivers to be communicated across the serial interface and fiber op-

tic cable, along with the mobile unit's normal digitized audio, data, command and status signals. "In that case, the number of parallel channels simply is increased before the serializing process begins."

Several other advantages are realized:

- The small-sized fiber optic cable is installed easily under carpet and behind molding.
- The risk of electrical shorts or igniting explosive fuel, fumes and cargo is eliminated.



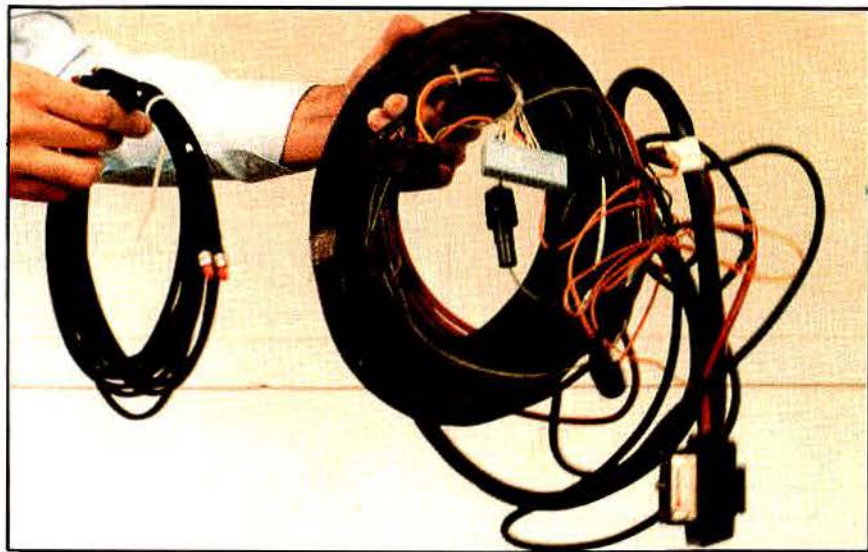


Photo 1. A thin, fiber optic control cable (left) and its connectors are much thinner and less bulky compared to the multiconductor copper wire control cable also shown. The multiconductor cable includes power leads; the fiber cable does not.

- Interaction with the vehicle's microprocessors and other electrical systems is eliminated.

- There is no cross-talk between the

conductors.

- The cable is immune to vehicular ignition noise or external interference.

"It is important for a mobile equip-

ment installer to become familiar with the properties of fiber optic cable," Kasparian said. "For example, replacing one fiber optic cable with another that seems similar is not advised without verifying that their characteristics are equivalent.

"Plastic fiber optic cables shrink when used in high-temperature environments. They should be pre-shrunk before being used as control cables. If the manufacturer has not pre-shrunk the cable, the installed cable may be subjected to damaging stress when heat causes it to shrink.

"Connections must be made correctly.

"The cable must not be bent to a sharper radius than its manufacturer specifies as a minimum bending radius.

"Axial stress (force exerted along the length of the cable, as in pulling) has a limit. Pulled too sharply, plastic fiber optic cables yield and deform, producing signal mutilation. With some commercial fiber optic cables, the maximum

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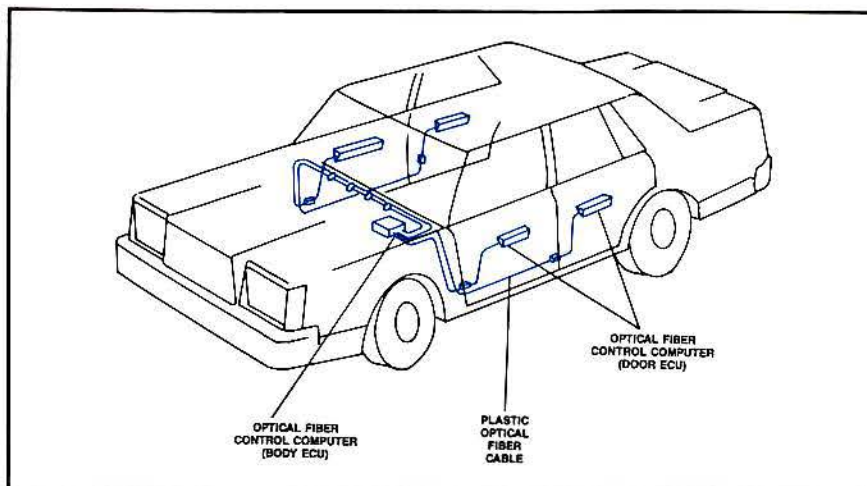
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**Figure 1.** Fiber optic cable connects dashboard controls with electrically operated devices such as door locks, power windows, power seats and lights. It carries data for the dashboard monitor display.

mercial fiber optic cables, the maximum axial stress is 10kg (22 pounds), well within the capability of an adult exerting a sudden pull on the cable," Kasparian warned.

Vehicle manufacturers use fiber op-

tic cable to control various electrical devices, as shown in Figure 1 above. The relatively thin cable is easy to route.

Wire routed through areas with electrical noise can pick up the noise and reradiate it where it may be picked up

by the communications radio antenna or other cables connected to the transceiver. One area where electrical noise may be present is the dashboard.

By using fiber optic cable to connect electrically operated devices in other parts of the vehicle with their dashboard controls, auto manufacturers eliminate one possible cause of interference with reception.

As two-way radio and automobile manufacturers make more use of fiber optic cable, the potential for interference to radio communications caused by the vehicle engine will continue to be reduced.

#### Further reading

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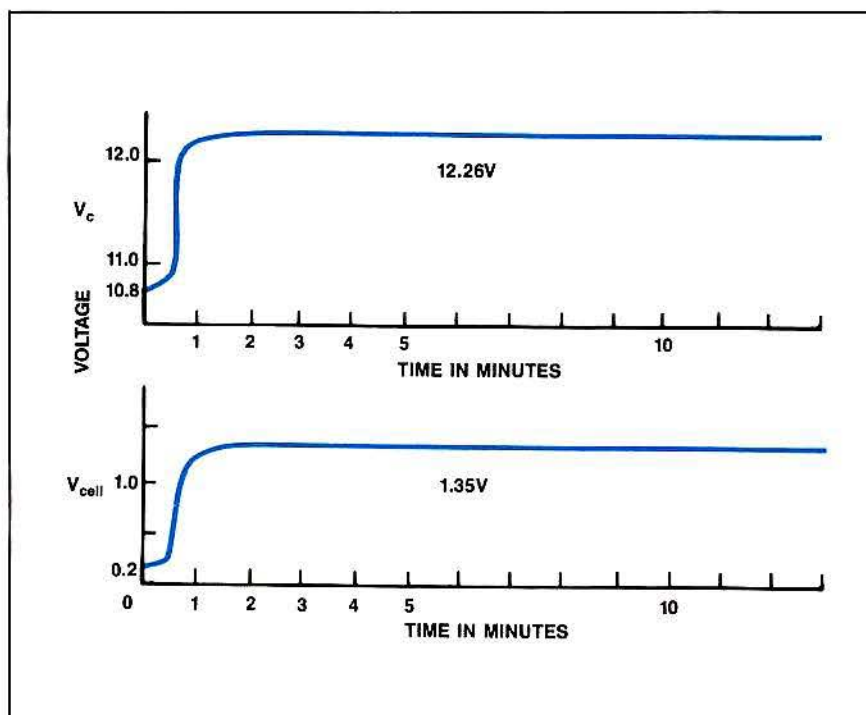


Figure 3. Voltages recorded on a strip chart using the setup of Figure 1. The lead-acid battery's voltage rose along with the voltage of the 'discharged' nicad cell it charged.

the possibility of overvoltage," a report on the experiment Hershkowitz prepared reads. "When the stack is fully charged, the stack draws no current."

The report notes that the Henkel circuit can be used to charge any cell that has an internal resistance much lower than that of the charging source.

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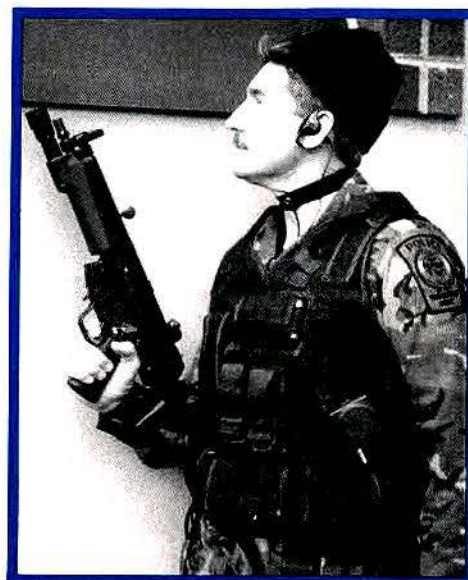
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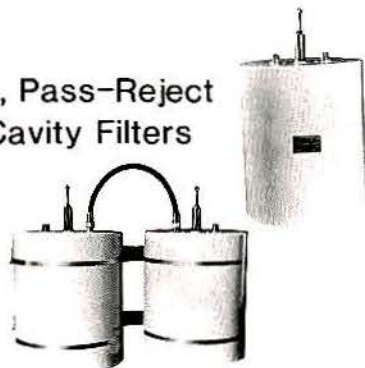
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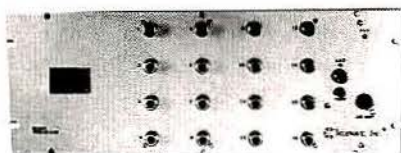
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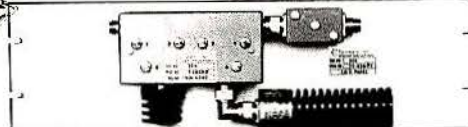
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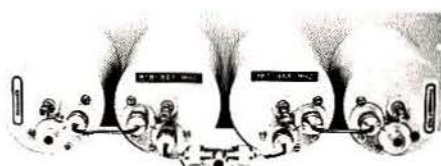
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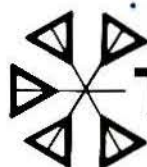
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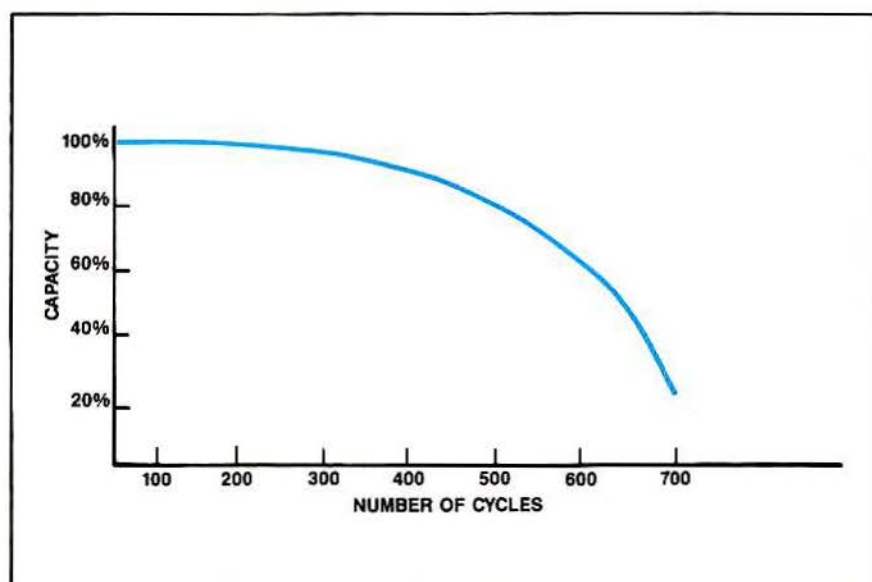
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# Getting the best charge from your nicad batteries

*What some call 'memory effect' really is the result of improper charging. Proper charging avoids undercharging and overcharging; both reduce battery capacity. Voltage measurement offers the best charging control.*



**Figure 1. Capacity vs. cycle life.** Cycle life is the number of times a battery may be charged and discharged. For nicads, it is reasonable to expect a life of 500 to 600

charge-discharge cycles. During its cycle life, the battery's actual capacity, expressed as a percentage of its rated capacity, declines.

**By Bob Williams**

Getting the highest capacity per charge and the greatest number of charges during the life of the battery is the goal of nicad (nickel-cadmium) battery management. The goal is reached with proper charging techniques that avoid undercharging and overcharging.

**Capacity** is the battery's ability to deliver power for a given length of time. Capacity lost by improper charging means a battery may not last a full

workshift before its charge is spent. In many cases, lost capacity may be restored by "exercising" the battery—running it through several controlled charge-discharge cycles.

**Cycle life** is the number of times a battery may be charged and discharged. For nicads, it is reasonable to expect a life of 500 to 600 charge-discharge cycles. (See Figure 1 above.) Improper charging may reduce battery life.

## Memory effect

When some nicad battery users complain of a battery's loss of capacity, they blame it on "memory effect." True memory effect results from a series of

shallow discharges to exactly the same point, followed by recharging. The incidence of true memory is virtually nil.

Although true memory is so rare it can be considered nonexistent, other problems common to nicads often are blamed on the so-called "memory effect." For example, voltage depression resulting from overcharging causes reduced capacity. So does deep discharging below 1V per cell, to a point where cell polarity reverses. Capacity reductions caused in these ways often are wrongly blamed on "memory effect." A proper charging system not only can determine how long and how well your batteries work but can eliminate the risk of overcharging the batteries, thus eliminating "memory effect."

"Overcharging" means applying extra electrical energy to the cells after they have reached full charge. It causes a change in the negative plate's molecular structure.

Voltage depression inhibits the battery's ability to deliver its full capacity. A battery suffering from voltage depression cannot deliver full power because power ( $P$ ) is the product of current ( $I$ ) and voltage ( $E$ ), i.e.,  $P = E \times I$ . A voltage reduction therefore reduces power. (See Figure 2 on page 32.)

Charging batteries at high temperatures limits the amount of charge the battery receives because it self-discharges nearly as fast as it charges. When the charging current is removed, the battery's voltage is lower than it would be when charged at a normal temperature.

When a battery charged at a high temperature is placed into service, it begins delivering power at the lower

Williams is a battery specialist at Alexander Manufacturing, Mason City, IA.



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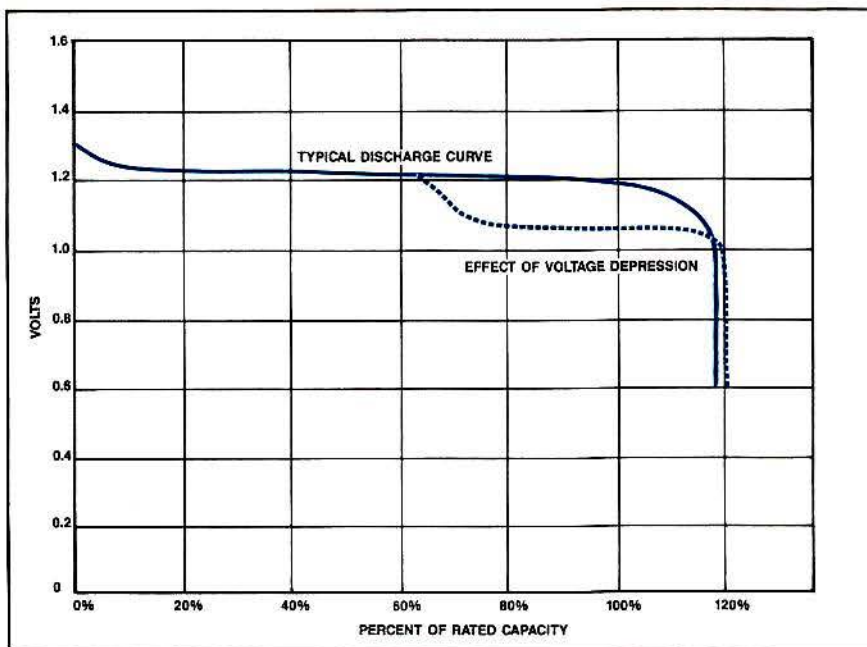
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**Figure 2. Overcharging, charging at high temperatures and discharging to less than 1V per cell can result in voltage depression that reduces a battery's apparent capacity.**

voltage, and it reaches its cutoff voltage sooner, once again giving the illusion of "memory effect" or reduced capacity. (See Figure 3 on page 34.)

Voltage depression is a temporary problem. It can be eliminated easily by slowly charging and discharging the battery through three or four cycles. Nonetheless, using the proper charger can eliminate the possibility of voltage depression and avoid "memory effect" at the outset.

#### **Different charging methods**

Among the various charging methods are those that use heat sensors, timers, trip-point voltage measurements and the negative voltage slope.

- **Heat sensor**—Chargers that use heat sensors have the potential to overcharge and damage a battery. Heat-sensor systems measure temperature increases in the battery. When the battery reaches full charge, the chemical process that stores electricity ends and electrolysis begins. Electrolysis produces gases that increase the battery's internal pressure, causing heat.

A heat-detecting device, a thermistor, switches the charger from full current to trickle current when it detects a temperature increase. Unfortunately,

although it is not true memory, voltage depression often is referred to by nicad battery users as "memory effect."

thermal inertia delays the migration of heat to the thermistor. By the time a temperature increase is detected, internal gas pressure already may have reached dangerous levels and may have damaged the cells.

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*Among the various charging methods are those that use heat sensors, timers, trip-point voltage measurements and the negative voltage slope.*

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- **Timer**—Because timer-based systems charge batteries for a predetermined length of time, regardless of battery condition, they have a tendency to overcharge or undercharge the battery. For instance, a fully charged battery taken into the field, discharged to 40% of its capacity and returned for charging should not be charged for the same

length of time as a battery discharged to 70% of its capacity. But a timer-based charger would charge both batteries the same period, thus possibly overcharging or undercharging them.

- **Trip-point voltage**—Another common charging method, based on the trip-point voltage, is somewhat better than the first two, but it still has a major drawback. A charger built to use this method detects when the battery voltage reaches a predetermined point. At this point, the charger switches to a "trickle charge" current of a few milliamperes.

As an example of the drawback, such a charger built to switch when the battery voltage reaches 3V would overcharge a 1.5V battery. The same charger would undercharge a 5V battery.

This type of charger is difficult to use because it must be reset for different voltages, a procedure that often is confusing and time consuming.

- **Negative voltage slope**—The safest, easiest charging method, one that avoids "memory effect," uses the negative voltage slope. A charger built to use this technique detects the tiny voltage drop that occurs after the battery reaches full charge.

The charger uses a microprocessor to control a continuous series of voltage measurements for each battery during the charging process. As the battery accepts charge, its voltage rises. When it reaches full charge, its voltage peaks. As it begins to overcharge, its voltage drops. The charger detects the tiny drop in voltage.

At that point, the microprocessor switches the charging current to a 9mA trickle charge, which maintains the battery at full charge.

The charger, which may be configured to charge several batteries at once, treats each battery individually. It can charge batteries with different voltage ratings simultaneously without the risk of voltage depression or overcharge. A variety of batteries can be charged by the same charger.

#### **Trickle charge**

When choosing a charger, check the trickle charge rate. Many chargers charge batteries only to 80% of their capacity (full charge). These chargers then indicate full charge while continuing to trickle-charge the battery until it



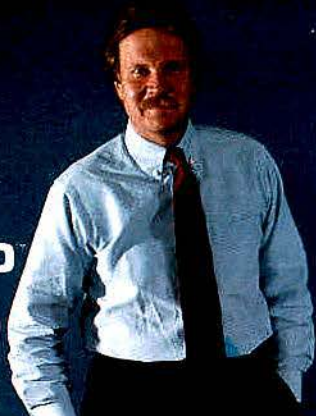
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1 toll-free call

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Robert B. Barnhill, Jr.  
President

## "If you buy factory-direct for the savings, I've got some news that might surprise you."

When you spend the extra time and effort to purchase your land-mobile communications products factory-direct, you might expect to save a little money. But the truth is, you probably aren't saving a dime. In fact, if you take a closer look, you could find you're working harder and actually *spending more* at the factory for the very same products you can get with one toll-free call to TESCO.

In a recent test conducted by a national, independent delivery-tracking firm, TESCO supplied product faster, more reliably, and more economically than the factory.\*

To prove our point, we commissioned U.S. Monitor Service, an independent delivery-tracking firm, to place a typical cellular/two-way supply order, first with the product manufacturers, and then

with TESCO. In all, 10 well-known manufacturers were represented, so naturally, we expected some stiff competition. What we got, however, might surprise you.

**The sample order placed with TESCO yielded a total cost savings of more than 15%, plus weeks in delivery time over factory-direct.**

Because we stock products from over 70 top manufacturers, it took just 5 minutes and 1 toll-free call to place the sample order with us. To get the same items direct from the various factories took 10 calls (5 were toll calls) and over half an hour!

More importantly, TESCO had the items in stock. And we delivered everything in 1 shipment in just 2 days via regular UPS. The factory shipments, on the other hand, arrived sporadically, taking anywhere from 3 to as many as 42 days.

And because the factories had to ship 10 separate, smaller orders instead of just 1, shipping costs were an incredible 73% lower for the items ordered from TESCO.

But for those of you who swear by the factory for low prices, this last point may be the most surprising of all: TESCO's combined *item* costs were actually 13% less than the identical items ordered direct from the factory!

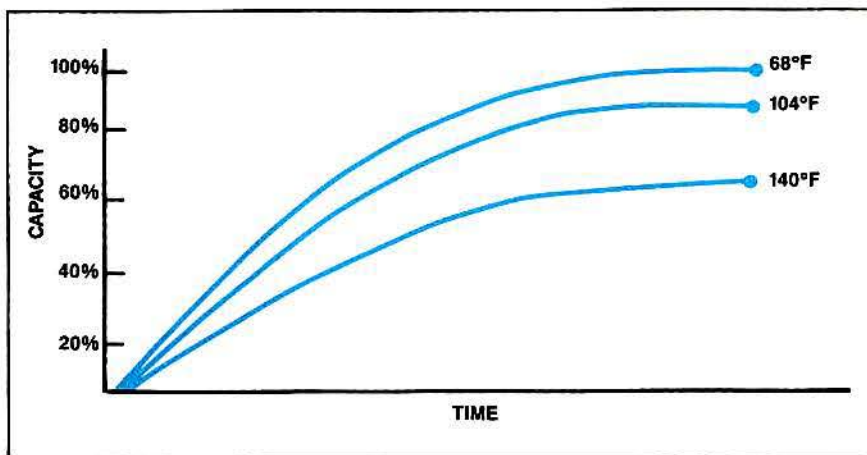
So go ahead, give TESCO a call today. You might just find we do it better, faster and cheaper than factory-direct.



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\*For a copy of this report, write us at:  
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**Figure 3. Charge acceptance at different temperatures. A nicad battery's full-charge capacity, expressed as a percentage of rated capacity, is lower at higher**

**temperatures. It also reaches full charge faster at higher temperatures than at room temperature, increasing the risk of overcharging.**

reaches 100% of its capacity. (If the battery is removed from the charger immediately after full charge is indicated, it actually is at 80% of full charge.) On the other hand, if the battery is left on the trickle charge rate for several days, it may become overcharged.

For maximum performance, nicad batteries must be charged to 100% of capacity and then maintained on an extremely low trickle charge (on the order of 9mA) to maintain full charge. This procedure keeps the battery ready for use without self-discharge and eliminates the risk of voltage depression.

The most recent advancement in chargers is an analyzer that measures a battery's exact capacity before it is taken into the field. Previously, one method used to estimate battery capacity required recording how long each battery has been used in the field. But by analyzing the battery electronically, the battery manager can be certain whether it has enough capacity to last a hard day in the field.

Analyzers prolong battery life by conditioning them. They also can be used to measure newly purchased batteries to confirm whether they have their advertised capacity.

Analyzers allow seldom-used batteries, such as those kept for backup, to be placed into service on demand by exercising and conditioning them. Three or four charge-discharge cycles erase any "memory effect" that might be associated with voltage depression.

To use an analyzer for this purpose, first charge the battery fully to detect the exact full-charge point. The analyzer microprocessor will read and store the full-charge data.

Then use the analyzer to discharge the battery fully. The microprocessor will calculate and display the difference in capacity.

The analyzer then returns the battery to a full charge.

By running the battery through three to four cycles, the analyzer conditions the battery. When conditioning the battery, make sure the battery reaches full-charge and full-discharge points. A full discharge is defined by a voltage reading of 1V per cell. Beyond this point, the voltage drops dramatically.

For example, a radio battery's voltage can drop from 1V to 0V in less than a minute. This condition causes cell polarity reversal and severely damages the battery. Full discharges followed by full charges increase the capacity and voltage of a battery suffering from depressed voltage.

### **Charger and battery maintenance**

Properly charging batteries ensures top performance and longer life from nicad batteries. Regardless of what type of charger you use, basic charger and battery maintenance procedures extend the life of chargers and batteries alike.

Keep all charger and battery contacts clean. Dirty contacts can result in a charge malfunction. A defective charger can damage your batteries and give a

false reading. If continual overcharging occurs, the "memory effect" may result. Severe overcharging may cause the battery to explode.

Always operate batteries below 120°F. Low temperatures do not hurt batteries. High temperatures cause the battery to self-discharge, speeding natural deterioration and reducing the battery's capacity. At room temperature (68°F), nicad batteries self-discharge at a rate of 1% of capacity per day.

Nicad batteries are designed to be operated and charged at 68°F. Reaching full charge takes less time in high temperatures. When using a charger with a trickle charge higher than 9mA in high temperatures, watch the charger carefully. Remove the batteries immediately after they reach full charge to avoid overcharging.

For example, a battery being charged at 120°F is already warm; it will not take as long to charge as it would at room temperature. It must be removed from the charger as soon as possible after it reaches full charge to avoid overcharge.

A battery being charged at 50°F does not charge as fast and does not need to be removed from the charger as quickly. Ideally, a battery should be brought to room temperature prior to charging.

Check each battery's capacity every three months under normal use. If a battery exhibits reduced capacity, analyze it during two or three discharge-charge cycles to ensure it can deliver its fullest capacity. Nicad batteries should last 500 to 600 charge-discharge cycles.

Do not fast charge batteries stored more than six months. Recharge them with a slow charge over 14 to 20 hours. A fast charge can be used for subsequent charges.

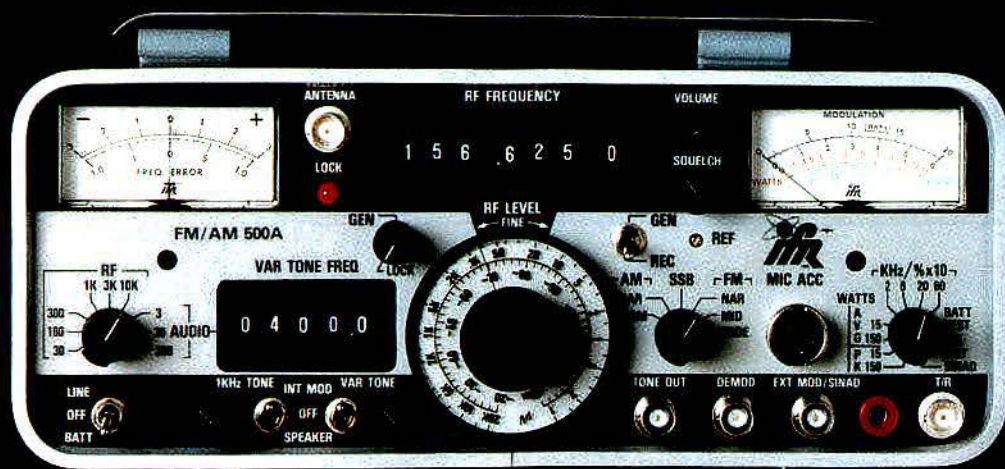
Never fast-charge batteries at temperatures below 40°F. The chemical reactions that store the charge occur more slowly below 40°F, so the battery will not accept a high current. When a high current is used to charge the battery at low temperatures, pressure builds up in the cells, and they lose capacity.

Using a proper battery-charging system allows radio managers to be sure the batteries sent into the field are operating at their highest capacities and powering radios to their greatest capabilities.





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“Micro-Monitor” from **IFR**

From the beginning, we have always kept with our commitment to offer the highest quality, along with the best value, of any service monitor available. We are sure you will agree that the FM/AM-500A is superior to any low cost monitor on the market today...and most costing thousands of dollars more.

You asked for more features and here they are — **All Standard with the FM/AM-500A:**

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## News

He said mobile communications affects every phase of our lives, and broad changes have affected the industry, including:

- "Industry has gone from an environment of monopoly to deregulation."
- "Semiconductor technology has paved the way for growth."
- "The switch from analog to digital

has brought technological advances."

• "A free market has emerged over the years."

• "Enhanced services are the order of the day."

With change comes opportunity, Hunt said. "Opportunity abounds for everyone. The '90s will be tougher and challenging," Hunt said. He cited "time is of the essence" and "lean and mean

staffs will prevail" as reasons for hardship in the '90s. "In order to stay competitive, companies must become global."

### Antenna Company garners glass-mount technology patent

The Antenna Company, Broadview, IL, has acquired a patent that covers improvements and methods for mounting and tuning a whip-type antenna in connection with a mobile, high-frequency transceiver. Known as the Kirkendall patent No. 4,089,817 and filed in 1976, it is one of the earliest patents relating to the mounting of an antenna to a windshield without the defacement of vehicle structure or the use of special fasteners or tools.

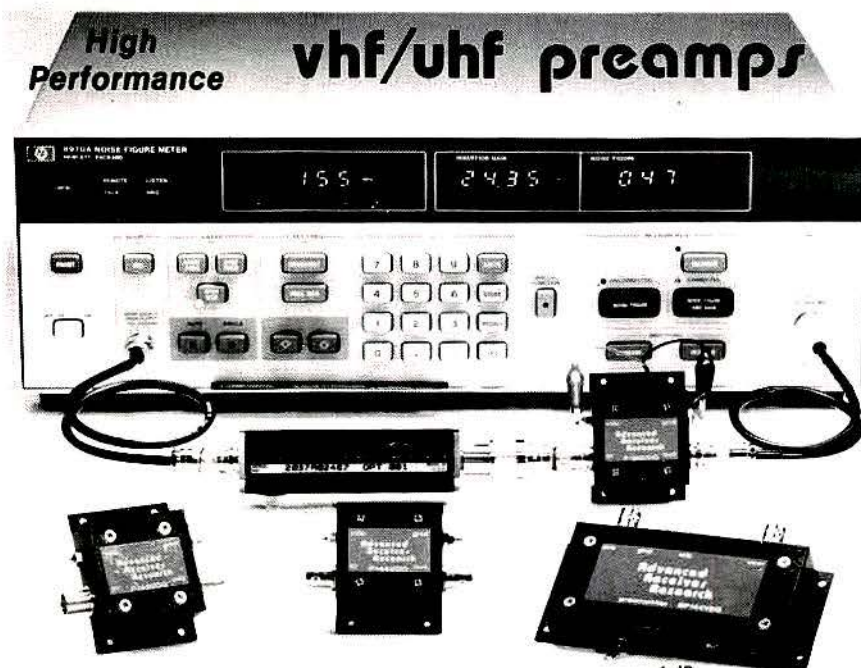
Inventor Dennis Kirkendall "saw the need for it many years ago, even pre-cellular," according to Antenna Company president Roger Fisher.

Kirkendall said he conceptualized the window-mount antenna in 1974 when his wife had a CB radio and he started to look for a suitable antenna. "For a CB antenna, most were \$50 and you had to drill a hole in a vehicle to install one, so I pursued the idea of an antenna mounted to glass and applied for a patent in 1976," he said.

With the patent acquisition, Antenna Company will call upon Kirkendall to enhance its current technology and expand its product line. The technology of the patent has been used by Decibel Products, Dallas, in its glass-mount antennas, and now royalties for the continued use of the patent will be collected by Antenna Company, according to Fisher.

### Celwave acquires Bogner land mobile antenna line

Bogner Broadcast Equipment, Westbury, NY, has sold its land mobile antennas to Celwave RF, Marlboro, NJ. Celwave secured the rights to more than 100 models of land mobile antennas and already is manufacturing 800MHz and 900MHz antenna product lines in its plant. Celwave will carry the antennas under the "Penetrator" name. Bogner continues to make broadcast antennas but is expected to sell the rest of its holdings in the next six months.



Receive only	Freq. Ranges (MHz)	N.F. (dB)	Gain (dB)	Comp. (dBm)	Device Type	Price
P30VD, P35VD, P40VD, P45VD	30-35, 35-40, 40-45, 45-50	<1.3	15	0	DGFET	\$ 44.95
P30VDG, P35VDG, P40VDG, P45VDG	30-35, 35-40, 40-45, 45-50	<0.5	26	+12	GaAsFET	\$109.95
P150VD, P160VD, P170VD	150-160, 160-170, 170-180	<1.5	15	0	DGFET	\$ 44.95
P150VDA, P160VDA, P170VDA	150-160, 160-170, 170-180	<1.1	15	0	DGFET	\$ 56.95
P150VDG, P160VDG, P170VDG	150-160, 160-170, 170-180	<0.5	24	+12	GaAsFET	\$109.95
P450VD, P460VD	450-460, 460-470	<1.8	15	-20	Bipolar	\$ 49.95
P450VDA, P460VDA	450-460, 460-470	<1.2	16	-20	Bipolar	\$ 74.95
P450VDG, P460VDG	450-460, 460-470	<0.5	16	+12	GaAsFET	\$109.95
P800VDG, P830VDG, P860VDG	800-830, 830-860, 860-890	<0.6	19	+12	GaAsFET	\$119.95
<b>Inline (rf switched)</b>						
SP30VD, SP35VD, SP40VD, SP45VD	30-35, 35-40, 40-45, 45-50	<1.4	15	0	DGFET	\$ 74.95
SP30VDG, SP35VDG, SP40VDG, SP45VDG	30-35, 35-40, 40-45, 45-50	<0.55	26	+12	GaAsFET	\$139.95
SP150VD, SP160VD, SP170VD	150-160, 160-170, 170-180	<1.6	15	0	DGFET	\$ 74.95
SP150VDA, SP160VDA, SP170VDA	150-160, 160-170, 170-180	<1.2	15	0	DGFET	\$ 86.95
SP150VDG, SP160VDG, SP170VDG	150-160, 160-170, 170-180	<0.55	24	+12	GaAsFET	\$139.95
SP450VD, SP460VD	450-460, 460-470	<1.9	15	-20	Bipolar	\$ 79.95
SP450VDA, SP460VDA	450-460, 460-470	<1.3	16	-20	Bipolar	\$104.95
SP450VDG, SP460VDG	450-460, 460-470	<0.55	16	+12	GaAsFET	\$139.95

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# Read Left to Right No Matter How You Look At It!

## Unique Reversible Display

The all new RSP 500 features a unique alpha-numeric reversing display so you will always be able to read it right-side-up, no matter how it is being used. In normal operation, the RSP 500 display reads from the front. When belt mounted with the optional remote speaker/mic, the display reverses itself so even though the radio is facing away from you, the display is still readable. Now you will never have to guess about your radio's status.

## Instant Priority

Hazardous or life-threatening situations call for immediate action. Instant Priority™ gives you instant communication at the single touch of a button. With that touch, you immediately place your radio in the manual mode, at its highest power level, and on your highest priority channel. Instant communication for an immediate response.

## Easy Operation

The RSP 500 was designed with you in mind. Besides its unique reversible display and Instant Priority™, the RSP 500 can be completely controlled from just four function keys. The keys are located in a specially bevelled faceplate so they can be easily seen and operated from any position. Both the Volume-on/off Squelch controls have knurled, rubber sleeved knobs for accurate non-slip grip.



## Loaded With Features

A multitude of features add to the RSP 500's versatility. Thanks to Track Tuning, it operates in the VHF band from 148 MHz continuously through 174 MHz with a full five watts of power, switchable to one watt when necessary. A fast scanning technique lets the RSP scan through its 20 channels at 40 channels per second...that means you will never miss an important transmission. CMOS technology provides for long battery life and the convenient snap on/off battery is a "snap" to change. CTCSS and Digital Coded Squelch, (DCS) which is completely compatible with DPL™, are built in. Non-invasive programming is provided through the mic jack and the RSP is easily clonable for fleet operation.

## Regency Plus Durability

Regency radios are well known for their durability, and the RSP 500 will be no exception.

The Right Radio  
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**Regency Land Mobile, Inc.**

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### Maxon adopts warranty program

Maxon Electronics, Kansas City, MO, has an upgraded product warranty to cover parts and labor for one year on Maxon manufactured products. Previously, labor cost were covered for only six months after the date of purchase.

### SEA appoints Michigan sales company

SEA, Mountlake Terrace, WA, has appointed Central Electronics Sales Company of Royal Oak, MI, as a marketing representative for the SEA ACSSB land mobile product line. Central Electronics is owned by Sam McMechan and Dale Van Dale.

### Mobile Data 9100 serving fire department

The Los Angeles County Fire Department has contracted with Mobile Data International, Vancouver, British Columbia, to provide approximately 800 mobile data terminals in the 9100 series to improve timeliness of dispatch response.

The terminals will help to serve an unincorporated area of Los Angeles County, covering 4,000 square miles that are protected by the Consolidated Fire District.

According to Bill L. Parker, project manager for Fluor Daniel, Irvine, CA, the company installing the system, the original 9000 series order was updated to the 9100 family in October to enhance a user's ability to interface with the dispatcher. The equipment also is better suited to deal with the physical elements of emergency site usage such as moisture, soot and grime.

The 9100 includes a wide range of preformatted layouts that will allow the fireman to request and receive information on the location of hazardous materials and sprinkler system hookups in the specific building. Parker said the system can incorporate custom formats for a particular building.

The installation phase of the project begins early this year and is expected to run for 1½ years. The cost of the project is estimated at \$23 million.

"The (LA county) fire department did their homework well," Parker said. "It really defined a nice package with the response format that helps in uniformity and training."

### Teletech awarded Ford contract

Teletech, a Dearborn, MI-based telecommunications consulting firm, has been awarded a contract by Ford Motor Company to assist in the evaluation and selection of cellular telephone equipment Ford may include as a factory-installed option in future Ford vehicles.

Teletech will evaluate technical, operational and other criteria on more than 20 different cellular phones. The evaluations will take place in an experimental cellular system built in Dearborn by Teletech.

## MICRO-MOTE® D. C. REMOTE CONTROL



- **Compact Design** - Measures only 5.6" W x 4.0" H x 3.6" D in stylish "speakerphone" housing compatible with most office decors.
- **Two Frequency Transmit** - for "talkaround" on repeater systems.
- **Intercom function** - for communication between control points without keying transmitter.
- **CTCSS Monitor Switch** - with line operated monitor indicator.
- **Simple Installation** - No internal adjustments. Includes modular phone jack, line cord, and a 42A wall mount terminal block.

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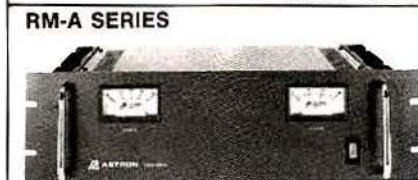
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MODEL VS-50M

- HEAVY DUTY • HIGH QUALITY • RUGGED • RELIABLE •
- RS, RM and VS SERIES**
- SPECIAL FEATURES**
  - SOLID STATE ELECTRONICALLY REGULATED
  - FOLD-BACK CURRENT LIMITING Protects Power Supply from excessive current & continuous shorted output.
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  - HEAVY DUTY HEAT SINK • CHASSIS MOUNT FUSE
- THREE CONDUCTOR POWER CORD
- ONE YEAR WARRANTY • MADE IN U.S.A.
- PERFORMANCE SPECIFICATIONS**
  - INPUT VOLTAGE: 105 - 125 VAC
  - OUTPUT VOLTAGE: 13.8 VDC  $\pm$  0.05 volts (Internally Adjustable: 11-15 VDC)
  - RIPPLE: Less than 5mv peak to peak (full load & low line)
  - Also available with 220 VAC Input Voltage



MODEL RM-35M

### 19" X 5 1/4" RACK MOUNT POWER SUPPLIES

MODEL	Continuous Duty (Amps)	ICS* (Amps)	Size (IN) H x W x D	Shipping Wt. (lbs.)
RM-12A	9	12	5 1/4 x 19 x 8 3/4	16
RM-35A	25	35	5 1/4 x 19 x 12 1/2	38
RM-50A	37	50	5 1/4 x 19 x 12 1/2	50
• Separate Volt and Amp Meters				
RM-35 M	25	35	5 1/4 x 19 x 12 1/2	38
RM-50 M	37	50	5 1/4 x 19 x 12 1/2	50



MODEL RS-7A

RS-4A	3	4	3 1/4 x 6 1/2 x 9	5
RS-5A	4	5	3 1/2 x 6 1/2 x 7 1/4	7
RS-7A	5	7	3 3/4 x 6 1/2 x 9	9
RS-10A	7.5	10	4 x 7 1/2 x 10 3/4	11
RS-12A	9	12	4 1/2 x 8 x 9	13
RS-20A	16	20	5 x 9 x 10 1/2	18
RS-35A	25	35	5 x 11 x 11	27
RS-50A	37	50	6 x 13 3/4 x 11	46



MODEL RS-35M

• Switchable volt and Amp meter				
RS-12M	9	12	4 1/2 x 8 x 9	13
• Separate volt Amp meters				
RS-20M	16	20	5 x 9 x 10 1/2	18
RS-35M	25	35	5 x 11 x 11	27
RS-50M	37	50	6 x 13 3/4 x 11	46

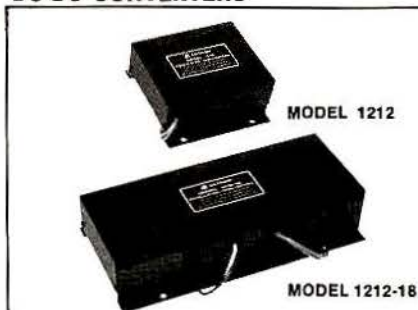


MODEL VS-35M

• Separate Volt and Amp Meters • Output Voltage adjustable from 2-15 volts				
• Current limit adjustable from 1.5 amps to Full Load				
@ 13.8VDC or 10VDC or 5VDC @ 13.8V				
VS-20M	16	9	4	20
VS-35M	25	15	7	35
VS-50M	37	22	10	50
• Variable rack mount power supplies				
VRM-35M	25	15	7	35
VRM-50M	37	22	10	50

\* ICS—Intermittent Communication Service (50% Duty Cycle 5 min. on 5 min. off)

## DC-DC CONVERTERS



MODEL 1212

MODEL 1212-18

MODEL 1212 & 1212-18 Switching Regulated Converter.			
Designed for FM transceivers and other applications requiring 12 volt power source converted from 12 volt positive ground battery. Regulation with pulse width modulation at 20 KHz.			
Input—12V DC (Positive ground only). Functional from -11 V DC to -16 V DC. Output +13.8 V DC (Negative ground only).			
Output Voltage	1212	1212-18	
	13.8 V DC	13.8 V DC	$\pm$ 2 V DC
Line/Load Regulation	200 mV	200 mV	
Ripple/Noise	50 mV RMS	50 mV RMS	
Current Continuous	6 Amp	14 Amp	
Current (ICS)	9 Amp	18 Amp	
Current Limit	12 Amp	19 Amp	
Case	2 3/4" (H) x 6" (W) x 6" (D)	2 3/4" x 6" x 12"	
Shipping Weight	2 lbs.	4 lbs.	



MODEL 2412

MODEL 2412-16

MODEL 2412 & 2412-16 Switching Regulated Converter.			
Designed for FM transceivers and other applications requiring 12 volt power source converted from 24 volt battery. Regulation with pulse width modulation at 20 KHz.			
Input +28 V DC (Negative ground only). Functional from +22 V DC to +32 V DC. Output +13.8 V DC (Negative ground only).			
Output Voltage	2412	2412-16	
	13.8 V DC	13.8 V DC	$\pm$ 2 V DC
Line/Load Regulation	200 mV	200 mV	
Ripple/Noise	50 mV RMS	50 mV RMS	
Current Continuous	9 Amp	16 Amp	
Current Limit	12 Amp	20 Amp	
Case	2 3/4" (H) x 6" (W) x 6" (D)	2 3/4" x 6" x 12"	
Shipping Weight	2 lbs.	4 lbs.	

ALSO! AVAILABLE AS MODEL 3612 & 3612-16: +36 V DC (Negative ground only) AND AS MODEL 4812 & 4812-16: +48 V DC (Negative ground only).



### Activus to develop Ready Talker pagers

Activus, Chatsworth, CA, has been formed by the principals of Minilec Services to develop and market Ready Talker paging products. Commonwealth Communications, Ashland, VA, will support the voice processing requirements at the paging terminal, as part of an exclusive licensing agreement under negotiation with Activus.

Richard Helferich, vice president of engineering at Minilec and inventor of the Ready Talker concept, is the president of Activus. Martin Schwartz, president and owner of Minilec, is the chief executive officer of Activus.

For more information contact Activus, 20812 Plummer St., Chatsworth, CA, 91311-5096, 818-998-0826.

### MCCA establishes new company

Mobile Communications Corporation of America (MCCA), Jackson, MS, has formed Mobile Telecommunications Technologies (MTEL). The new company will result from the merger of MCCA into BellSouth.

John N. Palmer, chairman of MCCA, will become chairman of MTEL. He said the merger and spinoff would be completed following final judicial and regulatory approvals that were expected to occur late in the fourth quarter of 1988.

### Yaseu uses national distribution plan

Yaseu commercial products are being sold exclusively through a chain of authorized regional distributors located throughout the country. The regional distributors are available from the company at 17210 Edwards Road, Cerritos, CA 90201; 800-544-9237.

Need a Cellular NAM Programmer?

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**Curtis Electro Devices, Inc.**

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Circle (44) on Fast Fact Card

# THE BOMAR Power Line

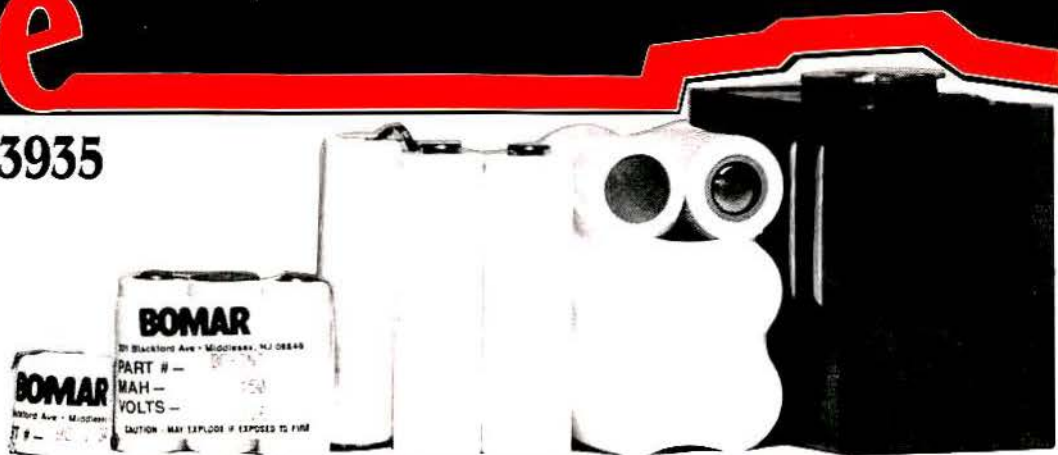
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For batteries that provide the power you need—when you need it. They are made to radio manufacturers' specs. Match the cosmetics of the radio. Guaranteed to work out of the box and main-

tain 80% rated capacity @ 12 months—are in stock for fast delivery. Service by professional sales and technical personnel. Make the BOMAR CONNECTION—Hotter than ever.

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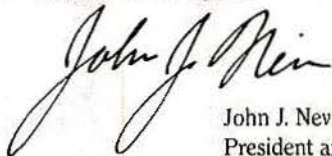


# THE QUINTRON PHILOSOPHY

"As a customer-driven company, Quintron has adopted a philosophy which demands we measure our success through your eyes. To do so, each of us strives to meet these basic business objectives:

- To perform each of our jobs in a manner that significantly contributes to your success.
- To back every Quintron promise and product with an absolute commitment to quality performance.

- To lead the industry with innovative technology and products which exceed today's requirements and meet tomorrow's needs.
- To maintain complete customer satisfaction through service and support excellence."



John J. Nevin  
President and CEO

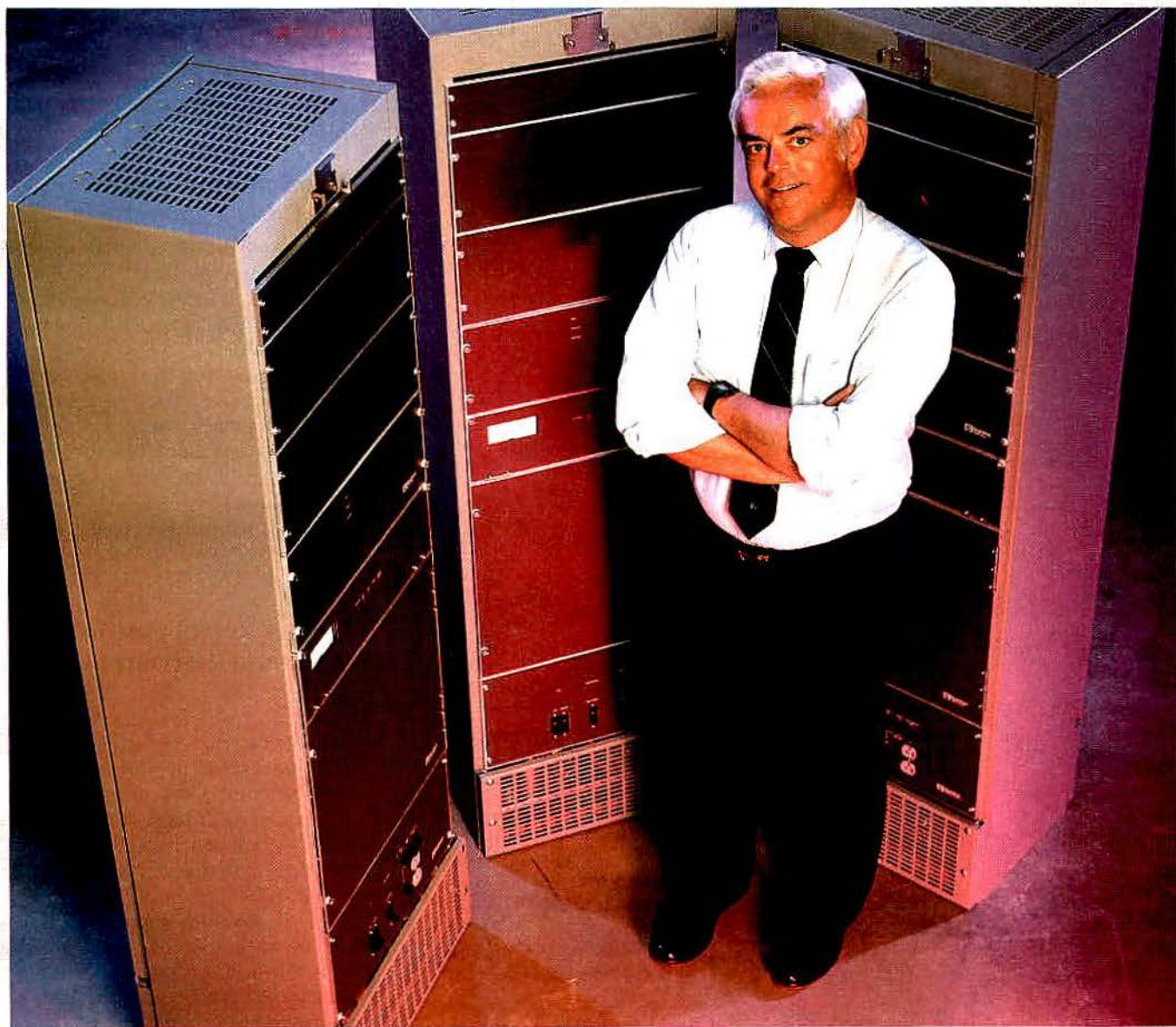
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# QUINTRON

Circle (46) on Fast Fact Card



## Neal Shepherd dies

Neal Shepherd, 67, chairman of the propagation committee of the IEEE Vehicular Technology Society, died at his home in Lynchburg, VA, after a short illness.

In 1946, Shepherd joined General Electric in Lynchburg, VA, where he held various positions until his retire-

ment in 1982. Early in his career he was responsible for the development of mobile communication equipment, design of L-band radar transmitters and the design of an antenna system for the Titan II weapons system sites. In the years prior to retirement, he was a consulting engineer engaged in the develop-

ment of advance mobile communication systems, propagation studies, noise measurements, standards committee work and international radio regulations. He had several technical papers published.

Shepherd was elected to the grade of *Fellow* in the Radio Club of America in 1978. He received the Avant Garde Award of the IEEE Vehicular Technology Society in 1980; the Founder's Award of the IEEE Electromagnetic Compatibility Society in 1983, and the IEEE Centennial Medal in 1984. He chaired a 900MHz radio propagation ad hoc committee of the IEEE Vehicular Technology Society.

A memorial fund has been established in his memory. Contributions may be sent to The Radio Club of America, Dr. Stoll, treasurer, P.O. Box 414, Bogata, NJ 07603.

## Magnavox names agent for Gulf Coast region

Magnavox Advanced Products and Systems Company, Torrance, CA, has appointed Steve Lieber & Associates of League City, TX, as agents for the Gulf Coast region.

The company will be responsible for sales, service and leasing programs for Magnavox's line of advanced electronic navigation, communications and survey systems throughout Texas, Louisiana and Mississippi.

For more information, contact Steve Lieber & Associates, 610 West Main St., League City, TX 77573; 713-332-4645.

## Glenayre covers province for Alberta government

Glenayre Electronics, Vancouver, British Columbia, has been selected to provide the technology and equipment for the installation of Alberta Government Telephones' new paging system.

The system can support full access, as well as remote terminals, from any centralized host for customer service and billings.

AGT's system will form a province-wide network using Glenayre's Telocator networking paging protocol supported by GL3000L paging terminals in Edmonton and Calgary.

PacTel Paging also has ordered GL3000L for its Los Angeles operation.



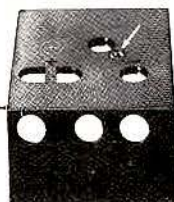
Save money without sacrificing quality . . .

## Completely repairable, all new nickel-cadmium battery packs

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All components  
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NCE P4463  
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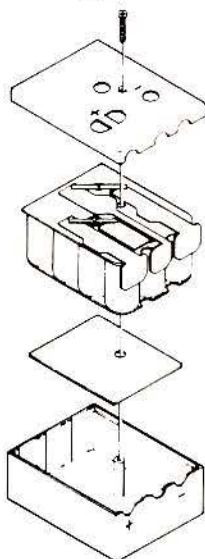
All NCE parts and components are brand NEW factory tested and approved. Damaged cases and components can be replaced without throwing away the complete unit. This increases the operating lifetime of your battery. It helps you maintain power inventory reserve and saves you money by eliminating unnecessary new battery purchases.

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## WE'VE BEEN OUT-TRUNKING THE INDUSTRY SINCE 1982.

Among all the trunked radio systems on the air, one has proven itself a clear favorite: Clearchannel LTR® from E.F. Johnson. It's so popular that other companies have built their trunking systems to LTR standards.

We're not surprised. For speed and efficiency, Clearchannel LTR

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Clearchannel LTR has already cleared the air in applications from construction to law enforcement. We can do the same for you. For our

free "Guide To Trunked Radio," call 1-800-247-8343 or write: Johnson LTR, P.O. Box 59089, Minneapolis, MN 55459-0089.

 **JOHNSON®**  
*The Clear Leader In Trunked Radio.*



## Annual meeting features 'Dollars & Cents Troubleshooting'

The Association of Communications Technicians (ACT) is a membership section of the National Association of Business and Educational Radio (NABER).

Technician members strengthen their earning power by sharpening their

technical skills at workshops the association sponsors and by reading ACT publications.

For example, NABER's annual meeting March 15-17 in New Orleans will include a workshop especially for technicians: "Dollars & Cents

Troubleshooting." Twelve educational workshops in all are scheduled. Some of the others are:

- "How to Find, Hire and Keep Good People"
- "Radio Transmitted Data: Is It for You?"
- "Customer Service! Getting the Competitive Edge"

Among the various ACT publications are *TechTalk*, a bimonthly newsletter sent to all members, and *TechTalk Plus*, a quarterly newsletter sent to senior members.

### Certification exam

ACT divides members into two categories: general and senior. Those who pass NABER's technician certification exam are eligible for senior membership.

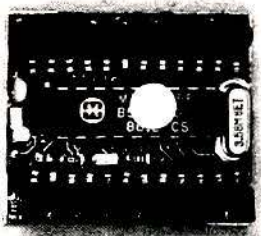
The next two tests for technician certification by NABER are scheduled for March and April. The March 31 exam will be conducted during the International Mobile Communications Expo in



Calls to the technician services office are fielded by technician services coordinator Sandra Assa (left) and administrative assistant Eunice Jones.

# MIDIAN

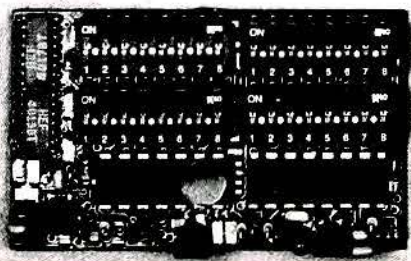
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#### Single Digit Touch-Tone™ Decoder

- Decodes 0-9, \*, #, A, B, C, D
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- Dipswitch programmable 1 to 8 digit phone number
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Circle (49) on Fast Fact Card



Las Vegas, NV. The April 8 exam will be conducted nationwide at various locations.

### 'Safety Corner'

One of *TechTalk*'s new departments is "Safety Corner." Here is an excerpt from the November issue:

The unusual catches our attention. Surely you have seen newspaper headlines about plane crashes. The larger the plane, the bigger the headline.

But have you ever seen the headline, "Falling Down Kills 75 People Today," on the front page? Of course not. But it is a fact. Every day, day after day, about 75 people are killed simply by falling down.

It is to be expected that a fall from a great height, such as from an antenna tower, would cause injury or death. Dangerous falls, though, can happen from relatively low heights or even on level ground.

It is easy to be careless, to overlook hazards, and to trip and fall, simply because we think danger only is relative

to the height. A fall from a ladder's bottom rung can cause a head injury, called a concussion, which may be serious.

Everyone has heard amazing accounts of people who fell out of tall trees, from high buildings, even from airplanes,

sustaining barely a scratch. Unfortunately, we often do not remember tales of injury caused by "simple" falls.

Cuts, bruises, wrenched backs, sprained ankles—all are common results from a fall. Each should be a reminder to everyone that it could have been much worse. The slip could have kept you from work, in bed, in pain, for weeks.

Think about the consequences of a "simple" fall. The resulting injury could be just as painful as injury caused by falling from a roof. Be aware of potential danger areas—ladders, stairs, uneven ground—yet remember, *any area may be hazardous* if you are careless or preoccupied, or if you cannot see where you are going.

Look around your radio shop and communications sites. Find and fix broken ladder rungs, poorly lit stairways and other hazards that may cause a fall.

But no matter how safe we make the workplace, *we all must be alert and keep our balance*. Let us remember to watch our step.



### Information

For information about ACT and NABER, call 800-759-0300.

☐ Technician workshops, registration and fees associated with the NABER annual meeting—ask for 'administrative services.'

☐ ACT membership—ask for 'technician services.'

☐ Technician certification—ask for 'technician services.'

# THE TWO WAY HANDHELDS THAT CAN HANDLE EVERYTHING EVEN LAYING DOWN



Whether its the harshest winter, a burning summer or a 24 hour day, the handheld portables from Tait Electronics keep coming back for more.

Customer designed conventional circuitry trims the cost, but not the reliability. With a complete range of accessories available these units are suitable for any application.



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## Data communications company promotes 900MHz SMR waivers

American Mobile Data Communications (AMDC), an offshoot of Ram Broadcasting, continues to pursue FCC rule waivers to permit construction of a nationwide 900MHz mobile data communications system in the specialized mobile radio (SMR) service.

AMDC seeks a lot of relief:

- five years for construction.
- permission to build multiple base stations within a designated filing area.
- permission to authorize other licensees with which it may sign agreements to build multiple stations.
- an interim stay of construction deadlines for certain other licensees.

The waivers are intended to give AMDC time and flexibility, otherwise unavailable under current rules, to build its network.

As the waiver consideration process moved into the reply comment period, AMDC responded to comments filed with the FCC in the proceeding:

- **McCaw Cellular**—A cellular service provider, McCaw claims no public

need for the service AMDC proposes has been demonstrated. AMDC countered with market research conducted by Arthur D. Little.

- **Providence Journal Telecommunications**—As another cellular service provider, Providence wrote the FCC that a rulemaking proceeding, instead of a waiver, would be more appropriate forum for AMDC's request. AMDC countered by citing waivers granted to IBM, the American Association of Railroads and San Bernardino County in California as precedents.

- **Cellular Telecommunications Industry Association**—A trade association of cellular carriers, CTIA asserts that specialized mobile radio service operators should offer only dispatch service to protect their status as private carriers. AMDC countered by citing the definition for common carriage, the resale of telephone service.

- **National Satellite Paging**—The paging company contends in its comments that a rulemaking proceeding

would be the proper procedure under which to consider AMDC's request. AMDC countered by citing NSP's own waiver that permits it to offer local paging services. In the NSP proceeding, the FCC rejected arguments that a rulemaking, instead of a waiver proceeding, would be appropriate.

- **American SMR Network Association**—A trade association of SMR system operators, ASNA opposes granting AMDC five years to build its network. Outside the 15 largest markets, ASNA's comment reads, 900MHz SMR spectrum shortages are not expected.

- **National Association of Business and Educational Radio**—A trade association with a division that represents SMR system operators, NABER is willing to consider whether a three-year construction period is reasonable, but opposes the five-year period. Its willingness to consider an extended construction period depends on whether equipment would be available to AMDC.

## Max-Range

### OMNIDIRECTIONAL BASE STATION ANTENNAS.

The MBX-150 and MBX-450 offer rugged construction, made of bright-dipped heat treated 6061-T-6 aluminum.

This uncompromising 4.5db design incorporates three half wave sections with a highly efficient phasing stub to give a very low angle of radiation.

- **Easy Assembly:** Can be assembled and tuned in 10 minutes.
- All **stainless steel** hardware. **Will Not Rust!**
- Tunable base match on high band model assure super low VSWR for maximum power transfer.
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MBX-150	4.5db	144-174 MHz	57.00
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MBS-450	3 db	450-470 MHz	32.50

Other frequency models available.

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## Trunking standard proceeding draws additional comments

As the public safety trunked radio equipment technical standards proceeding the FCC initiated with a *Notice of Inquiry* moved into the reply comment period, users and manufacturers stated their viewpoints:

- **North American Philips**—The U.S. affiliate of a trunking equipment manufacturing unit, Philips Radio Communications Systems of Cambridge, England, Philips' comment states that licensing delays are "not necessary consequences of moving forward with standards."

- **General Electric**—The manufacturer's mobile communications division proposed its own trunking protocol as a standard.

GE's filing reads that a standard would foster a wider choice for users, who could select different manufacturers' radios for different features, yet use them on the same system.

- **E. F. Johnson**—Although not favoring the adoption of a standard, the manufacturer wrote that if the FCC

picks a current manufacturer's protocol to be the standard, royalty fees charged to license it to others would affect their competitiveness.

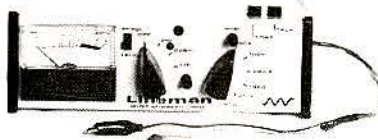
- **Los Angeles County**—The county asked the FCC to terminate the proceeding because, in its view, a standard could not be promulgated, adopted and executed in less than five years.

## Adding conventional channels to trunked systems approved

In the name of spectrum efficiency, the FCC has waived its rules on a case-by-case basis to allow 800MHz conventional channels to be added to trunked systems. Some of the recent waiver grants have gone to Motorola, WLAK Electronics Service and B & L Communications.



## IF YOU WORK ON SYSTEMS WITH PHONE LINES YOU NEED A LINEMAN™



MODEL LM-106 \$275.00  
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- Listen to the line or cable
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The PK-90 replaces the PK-80 Packet Radio Controller and brings you the above features NEW TO PACKET. Applications range from remoting a computer terminal through a radio link to control of distant equipment using the PK-90 with inexpensive SCADA controllers. You can coexist on a simplex channel with other voice or data users. Data is error-free, and the untrained user can learn station operation quickly. A station can cost less than \$1000. JUST CALL AND ASK!!

Ask about the PK-232 and PM-1 for SSB data transmission.

Your imagination is the only limit. Call John Gates, or circle the reader service number, DEALER INQUIRIES INVITED.

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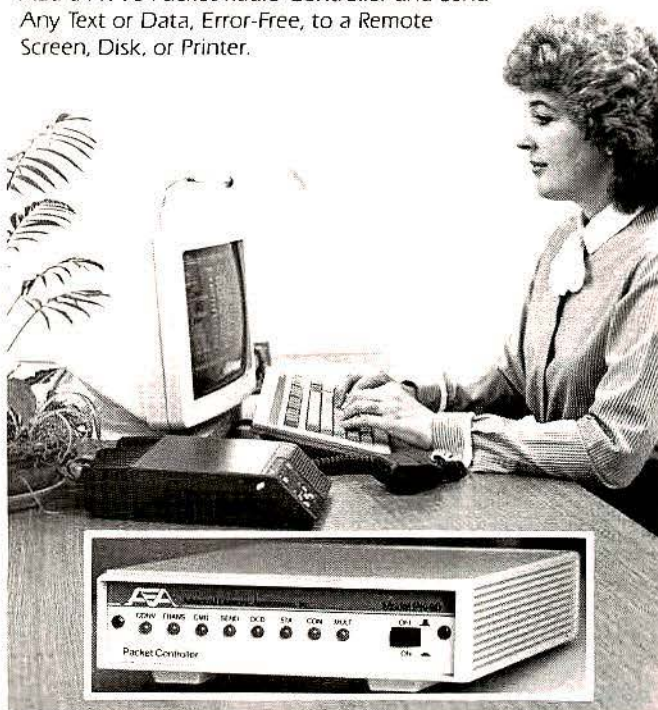
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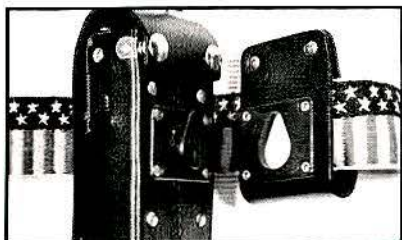
Circle (53) on Fast Fact Card



## Readers' choice

Of all the new products and services covered in the June 1988 issue of *MRT*, the ones reprinted here generated the most reader requests for additional information. If you missed them the first time, here is your opportunity to acquire more information on them: Just circle the corresponding Fast Fact number on the Fast Fact Card found in the back of this issue and mail the card to us.

### Radio cases fit 300 different models



### Steel plate lowers profile for mobile antennas

By upgrading the radiating elements of its low-profile mobile antennas from stainless-steel tubing to brushed stainless-steel plate, **Com-Rad Industries** has reduced the antenna's overall dimensions. Units are available for the 27MHz to 85MHz, 115MHz to 170MHz, 210MHz to 240MHz and 400MHz to 470MHz ranges. A single-feedline, dual-channel model for the

155MHz to 170MHz and 400MHz to 470MHz bands also is available. The directional discontinuity ring radiator design fits underneath vehicles for surveillance work. (The VHF lowband model is a helical antenna.) Mounted on top of a vehicle, the antenna's low profile avoids damage caused by structures with low clearances.

Circle (237) on Fast Fact Card

A leather hand-held radio case with a quick-release swivel is available from **A. W. Enterprise**. The teardrop swivel is made from ABS plastic. It permits quick detachment of the radio without removing the belt. Alternatively, the radio may be swiveled out of the way.

The case is made with top-grain

shoulder cowhide, stainless-steel hardware and zigzag stitching with nylon thread. The case is expected to last at least five years when it is used eight hours per day, or three years when it is used 24 hours per day. Cases are available to fit more than 300 different hand-held radios and can be ordered in custom grains, colors and styles.

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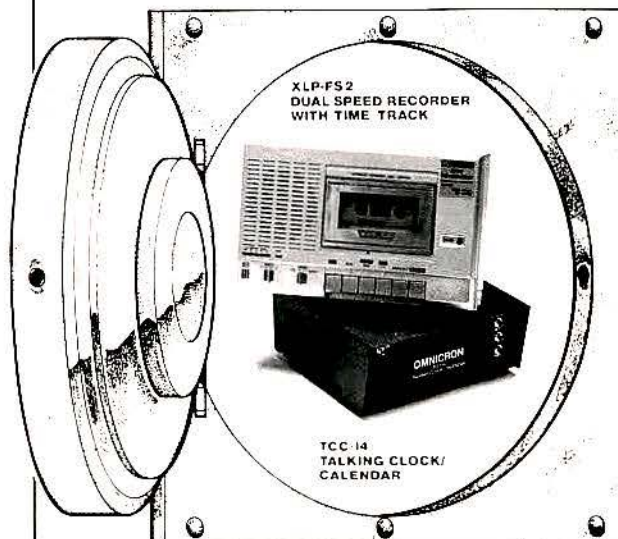


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- Up to 16 hours of talk time on a standard audio cassette, with time and date on a separate track
- Fail safe alarms prevent operator error
- Full line of accessories
- One button instant review of messages
- Easy installation



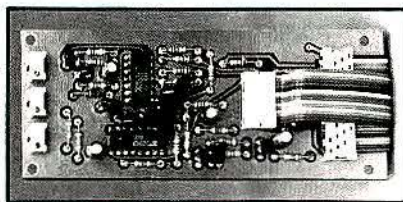
**OMNICRON**  
ELECTRONICS

1 MECHANICS STREET  
P. O. BOX 623  
PUTNAM, CONNECTICUT 06260-0623  
(203) 928-0377

Circle (55) on Fast Fact Card



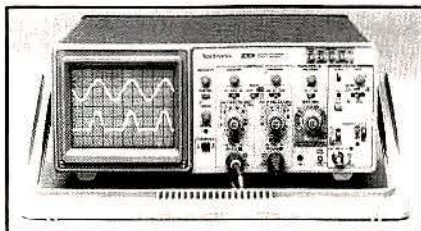
## Radio modem sends digital data through RF



The AFSK radio modem from **Neulink** sends digital data through radio channels. The transmitted and received data must be sent in a serial form, either TTL or CMOS with data transmission rates of 300 baud or 1,200 baud. The modem converts that data to one of two tones before applying the transmitters' modulation circuitry. These tones then are transmitted by the associated FM transmitter. With a 15-pin, D-style connector, the modem is compatible with most Neulink products.

Circle (384) on Fast Fact Card

## Digital scope stores as much as 2K data length

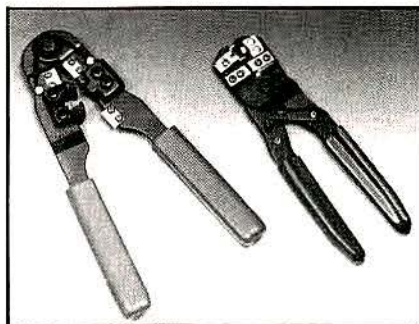


Circle (434) on Fast Fact Card

The 2201 digital storage oscilloscope from **Tektronix** offers 8-bit resolution, 1MHz storage bandwidth and 2K record length. Digital functions include 10MS/s sampling rate and pretrigger. Analog features include dual channels, 20MHz bandwidth and sensitivity from 5mV to 5V per division.

## Crimping tools are made of steel

Model 412 and model 413 crimping tools from **Telebyte Technology** handle connectors from RJ-11 to RJ-45. The heavy-duty crimp tools feature steel construction. Model 412 is used for RJ-45, eight-pin modular connectors and has cutting and stripping capabilities. Model 412 also attaches 8P8C cable. Model 413 also includes cutting and stripping and is used for six-position modular connectors with two, four or six contacts.



Circle (420) on Fast Fact Card

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**SUBTRACT**

all the delays, because we ship same day if you order by noon!

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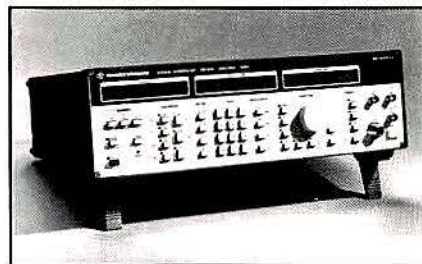
Circle (57) on Fast Fact Card

## New products

### 2GHz generator retains constant 1Hz resolution

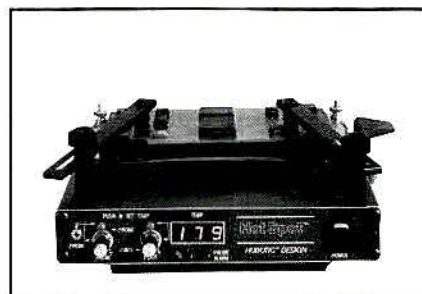
Model SMH signal generator from Rohde & Schwarz spans 100kHz to 2.08GHz with a constant resolution of 1Hz. Low distortion AM, FM and PM are standard, along with FSK modulation and phase-continuous digital sweep. As many as 50 panel setups can be stored and recalled in any sequence.

Circle (414) on Fast Fact Card



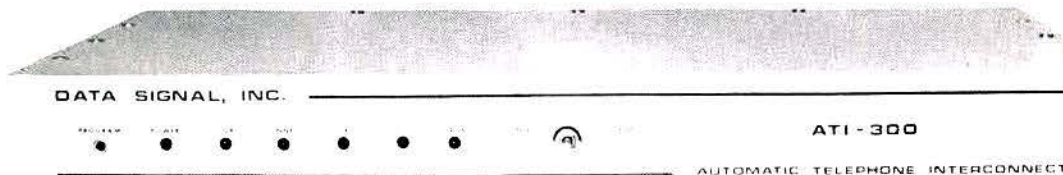
### Preheating system aids in rework of devices

The HotSpot HS-150 digital surface-mount device (SMD) preheating system from Pace Electronics is a self-contained unit that uses a conductive heating design in the rework and repair of SMDs. The system features a closed-loop temperature controller and digital temperature display. An audible and visual alarm can be activated when the temperature probe reaches a set temperature.



Circle (417) on Fast Fact Card

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# SMR Trunking Mobiles.

**N**eutec's 800 MHz trunking mobile is designed to push profits to the bottom line of any trunking or conventional system. "Thru-the-mic" programming and a "no-tune" design, reduce the labor that is costly with many of its competitors.

## Built For Long Life Reliability

The SM-1020T contains the latest in surface mount technology and hybrid module sophistication. Field tuning and aging problems are virtually eliminated due to minimized tuning components. Adding to this the radio's die-cast housing assures long-life reliability.

## Flexible Cloning Options

Cloning may be accomplished with either a cloning cable between two radios, or with an optional handheld memory unit for cloning or re-programming. This transport unit can read or write data without radio removal from the vehicle. This feature alone saves valuable time and can help control system piracy. Neutec also offers non-cloning versions to meet individual customer needs.

## LTR™ Trunking Compatibility

The SM-1020T is able to operate under full LTR™, or optional Americom compatibility on trunking systems with up to ten systems and ten group ID's. Conventional channels can also be programmed in any of the ten system positions; with optional CTCSS tone signaling.

## Programming Simplicity

Programming of the radio is easily performed on any IBM PC™ or compatible computer with Neutec's intelligent software and "thru-the-mic" programming cable. The inexpensive software package offers easy instructions and automatic creation of customer files.



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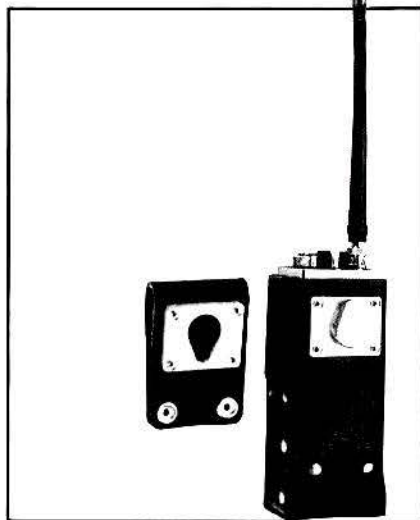


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Circle (60) on Fast Fact Card

## New products

Cases feature metal quick-release swivel



Hand-held radio cases from A. W. Enterprise feature rust-proof metal quick-release swivel. The swivel has a tear drop design for easy detachability.

Circle (429) on Fast Fact Card

## UHF mobile boasts 75W or 40W output

A UHF remote-mount mobile from Kenwood comes in two versions: model TK-822R(H) with 75W output and model TK-822R with 40W output. The mobiles have 32 channels and span 450MHz to 512MHz. Priority scan and channel scan are available. The mobiles feature heavy-duty, die-cast construction.

Circle (409) on Fast Fact Card

## Trunked system suits public works applications

The Sharenet 800MHz trunked communications system from Motorola uses an existing network of Motorola SMR systems to provide public works agencies with clear channel access, emergency call management and display of unit IDs. The system can overlay subsystem capabilities such as automatic vehicle location, secure voice protection, alarm and paging control, and paging and data communications.

Circle (412) on Fast Fact Card



## Belt-pack radio system offers hands-free use



The Belt-Pak radio system from **Earmark** combines a transmitter and receiver in one package, enabling hands-free operation. The pack operates with alkaline batteries of the company's rechargeable power system. Two types of antennas are offered for the unit, and a variety of headphones and mics, as well.

Circle (242) on Fast Fact Card

## Paging software line accesses six systems

Three versions of the PcPage software from **Metriplex** are available in an expanded form. The PcPage software's expanded features include automatic access to as many as six paging systems by selecting the name of the person to be contacted. National and local paging services may be intermixed in the same user database. Separate log files are available for each paging service. The

McPage software features a Macintosh user interface. The PcPage Pro software provides automatic routing to 50 paging systems and supports an expanded number of users and groups limited only by the memory of the host computer. PcPage Pro has a support program, PcPage Report, that generates usage data by user, paging system or time period.

Circle (352) on Fast Fact Card

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Circle (63) on Fast Fact Card





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These 5-watt/4-channel two-way portables are compact\* and lightweight, yet built tough enough to perform under rigorous conditions... year after year. Inside, there's advanced micro-circuitry on a durable FR-4 glass epoxy board. On the outside, there's a rugged, heat-resistant Noryl-190® case with a die-cast aluminum control deck, machined aluminum control knobs, and a metal BNC connector. ("HD" models, with a die-cast aluminum "H" frame, meet several criteria of MIL-SPEC 810D and offer an INTRINSICALLY SAFE option for many levels of hazardous conditions.)

Add to this a complete list of available accessories and tone signaling options, and it's easy to see why Maxon portables are preferred around the world.

### MOBILES

Maxon's 30-watt/4-channel mobile transceivers, with their rugged steel cabinetry, are only 1 3/4" high\*—allowing easier installations, even in smaller vehicles. The faceplate, microphone and optional auxiliary speaker are all made of tough, heat-resistant Noryl-190®. Plus, all controls feature bright LED indicators and are recessed for protection. Inside, solid state switching and advanced broad band strip technology assure you of spectral purity and frequency stability.

There's also a wide array of available accessories and tone signaling options.

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Circle (64) on Fast Fact Card

## New products

### Digitally trunked system covers 900MHz frequencies

Digital trunking in the recently allocated 900MHz spectrum is possible with **General Electric's GE-NET 900** communications system. The trunked system offers immediate and automatic channel access, privacy, call queuing, non-stop trunking, and individual and group ID assignments with multiple level addressing. The modular system allows customization and expansion.

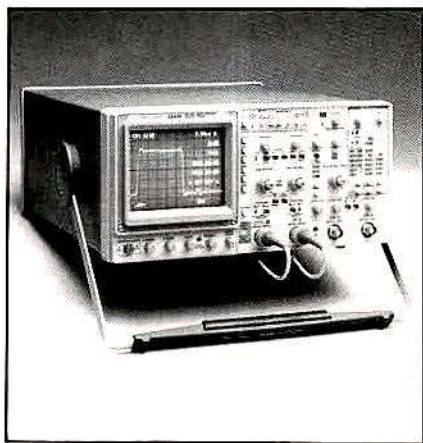
Circle (346) on Fast Fact Card

### 3W cellular mobile features 832 channels

The Radiant 832XL from **Antel Corporation** offers 832 duplex channels and 3W. Features include hands-free operation, speed dialing, call processing, scratchpad memory, DTMF, and automatic and last-number redial. A programmable lock, call timer, call in absence indicator and volume controls are included on the unit.

Circle (433) on Fast Fact Card

### Portable scope contains built-in counter-timer



The 2247A portable oscilloscope from **Tektronix** features a counter-timer, automatic rise-fall time and propagation delay measurements and other measurements. The 100MHz, four-channel oscilloscope provides auto setup, on-screen cursors and a many as 20 preprogrammed measurements.

Circle (422) on Fast Fact Card



## Protector safeguards 120Vac power lines to 15A

An in-line power line protector from **PolyPhaser Corporation** protects 120Vac lines to 15A. The protector has EMI-RFI filtering, which endures 20kA. The unit works in two stages for protection.

Circle (248) on Fast Fact Card

## Paging encoder offers talk-back capability

The H-2110 paging encoder from **Hyperdyne**, when used in conjunction with the company's F-2100 radiotelephone interface, enables two-tone sequential and DTMF paging formats. The paging encoder offers true DTMF regeneration and DTMF conversion to two-tone sequential. The DTMF regeneration function stores and regenerates as many as 32 digits. The unit can handle talk-back paging within the system.

Circle (432) on Fast Fact Card

## Control system monitors as many as 64 stations

The series 422 alarm and control system from **Raven Electronics** provides as many as 4,096 alarms and 2,016 control points per master station. As many as 64 remote stations may be used with each master station. Monitoring and control functions are programmable at the console. The polled system can communicate with an analog or digital transmission facility.

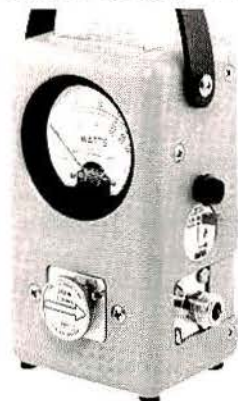
Circle (419) on Fast Fact Card

## Decoder-controller provides low current drain

Model 2204 controller and DTMF decoder from **Lucas Ledex** features low current drain, LED display with power-saver switch and wrong character reset or digit counting. It allows selective activation of 12 relays in a variety of operating modes: momentary, latch and no-two operate. The unit is for DTMF remote control.

Circle (243) on Fast Fact Card

## NEW Advanced Bird Model 43P Wattmeter



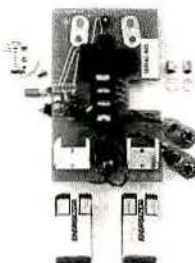
### MEASURES PEAK POWER OF SSB AND OTHER AM SIGNALS

The new Bird Model 43P Wattmeter — similar to our standard Model 43 Wattmeter — has the added capability of measuring audio peak power of single sideband and other AM modulated signals.

The Model 43P includes a peak measuring circuit board which mounts into the back of the Model 43 housing, enabling you to measure peak power to

an 8% F.S. accuracy, without affecting cw operation or accuracy. (Owners of the standard Model 43 can modify their own units with retrofit kit Model 4300-400.)

Contact your Bird distributor or the factory for details.



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## New products

### Digital soldering station uses temperature controller



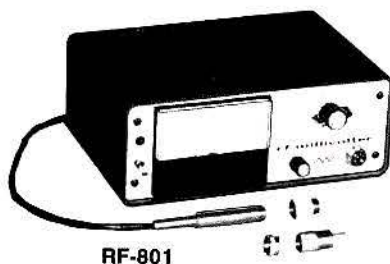
The MBT-210 digital soldering and desoldering station from **Pace Electronics** uses an electronic load-sensitive temperature controller that sustains operating tip temperature without loss. Tip temperature is settable within 1°.

Circle (418) on Fast Fact Card

### VHF lowband transmitters feature adjustable output

Three analog-digital VHF lowband transmitters from **Quintron** have continuous-duty rating and include a built-in high-stability oscillator. The units feature four channels and modular construction. The transmitters are designed to exacting simulcast specifications. Model QT-7095 operates on 150W to 350W adjustable output. Model

## RF MILLIVOLTER™



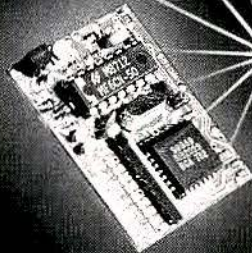
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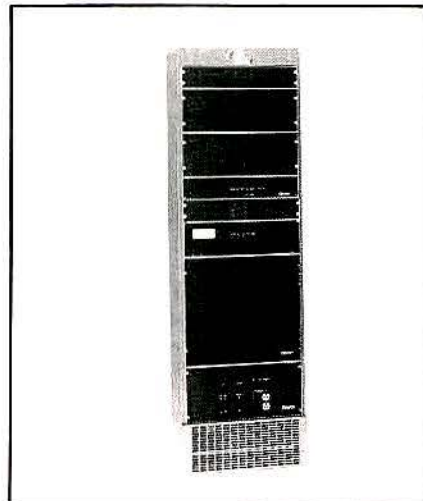
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Circle (68) on Fast Fact Card



QT-6085 and model QT-4085 offer 25W to 110W and 12W to 25W adjustable output power respectively.

Circle (223) on Fast Fact Card

### Lowband VHF mobile offers 60W output

The TK-622R VHF lowband remote-mount mobile from **Kenwood** offers 32 semi-duplex channels and 60W output. Priority scan and channel scan are available. Other features include LED display; noise blanker switch; heavy-duty, die-cast construction; and rugged mic. It comes with a heavy-duty external speaker and mic.

Circle (410) on Fast Fact Card

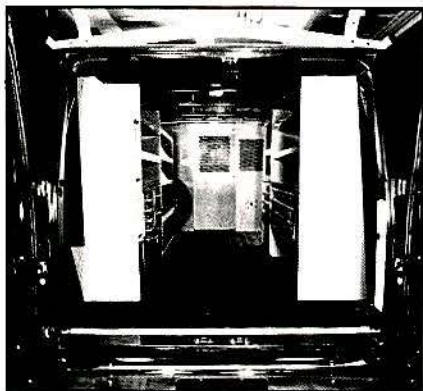
### Grounding kits fit equipment shelters

The Helo grounding kits from **Lightning Prevention Systems** fit buildings and enclosures of 4 x 4 feet through 20 x 20 feet and larger. The kits include ground rods, cables, clamps, hardware and mounting plates. They can be added to existing ground systems.

Circle (231) on Fast Fact Card



## Custom van shelving supports RF communications



Prepackaged and custom modular van shelving from **H&H Equipment Company** is suitable for radio communications service vehicles. The shelving keeps equipment organized with various components available, including drawer, bin, cabinet, rack, shelving and tray configurations. The units are designed to fit most vans and can be arranged into a variety of service modules.

Circle (244) on Fast Fact Card

## Signal intensifier pre-amplifiers cover MF to UHF range

The RFP-40 line of signal intensifier receiver pre-amplifiers from **Electron Processing** spans MF to UHF frequencies. The units provide 15dB gain from 1MHz to 1,300MHz. Models in the line are available with choice of BNC, UHF or F connectors and choice of 110Vac or 12Vdc. The pre-amplifiers have lightning and static protection.

Circle (234) on Fast Fact Card

## Digital numeric pager offers 8 access addresses

The SP200 digital numeric pager from **SilCom Communications** shows as many as 11 digits on an LCD. It features priority alert, memory reminder, as many as eight different access addresses in two groups and 400-digit memory. An optical programming link stores the unit's cap codes and optional features in EEPROM. The link allows operational features to be altered.

Circle (387) on Fast Fact Card

## Scanning receiver covers public service bands

The AR880 hand-held scanner from **Ace Communications** covers public service bands and the new services available above 800MHz in 12.5kHz and 25kHz increments. The 20-channel unit weighs 12 ounces and comes with two antennas and a belt clip.

Circle (225) on Fast Fact Card



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Circle (70) on Fast Fact Card

## New products

### Phone interconnect board is for use with repeater

The OB-3100 telephone interconnect board and software, when added to a CSI-32 Plus repeater tone panel, provides a fully integrated repeater tone panel and telephone interconnect. The Fone panel allows telephone interconnect to shared repeaters operating on busy channels. Available from CSI, the interconnect board and Fone panel system features include real-time clock, mobile activity timer, priority interconnect override, public or private mode selection, tone or pulse dialing and telephone access scheduling.

Circle (239) on Fast Fact Card

### Remote station packages power as many as 5 cards

Models 2504, 2504A and 2504B remote station packages from Lucas Ledex provide power for as many as five of the company's series 200 type cards. With the cards, status and alarm monitoring systems, analog telemetry or remote control systems may be specified. Models 2504 and 2504A are available with radio modules.

Circle (241) on Fast Fact Card

### Desktop repeater boasts adjustable power output

The TKR-830 synthesized desktop repeater from Kenwood offers 2W to 20W (dealer adjustable) with one channel. A built-in tone unit provides as many as eight different tones, including field-programmable multitone QT, digital QT and multisignaling unit. The unit covers 450MHz to 470MHz range.

Circle (404) on Fast Fact Card

### Delay off-timer for mobiles is offered

The DG 105 mobile radio delay off-timer from AAA Communication Manufacturers eliminates battery failure caused by neglecting to turn mobiles off. The device provides three to five hours' delay before equipment automatically turns off. The unit allows radio equipment to operate with the ignition switch off and with the keys removed.

Circle (232) on Fast Fact Card





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## New products

### Messaging terminal allows processing, memory expansion

The modular voice processing system (MVP) from **BBL Industries** suits cellular, RBOC and large service bureau markets. It has digital signaling technology and allows for a flexible array of trunks, storage, processing and memory expansion. It supports as many

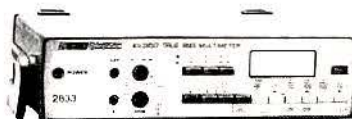
as 25,000 subscribers with 128 ports and 960 hours of storage. The terminal has redundant processors, databases, prompts, mailbox greetings and voice messages, remote diagnostics and prompt backup to streamer tape.

Circle (388) on Fast Fact Card

### Digital multimeters measure as much as 20A current



Model 2832

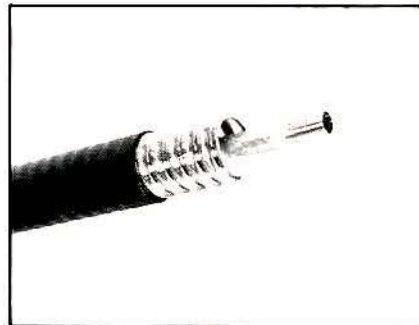


Model 2833

Two bench-style digital multimeters from **B&K Precision**, a division of Maxtec International, feature high-energy fusing and reverse-polarity protection. Model 2833 has a DCV accuracy of 0.05% and is a 4 1/2-digit RMS meter. Model 2832, a 3 1/2-digit multimeter and capacitance meter, offers DCV accuracy of 0.5%. Both units measure current to 20A and come with test leads, ac adapter, schematic diagrams and parts list.

Circle (435) on Fast Fact Card

### Coaxial cable features tubular center conductor



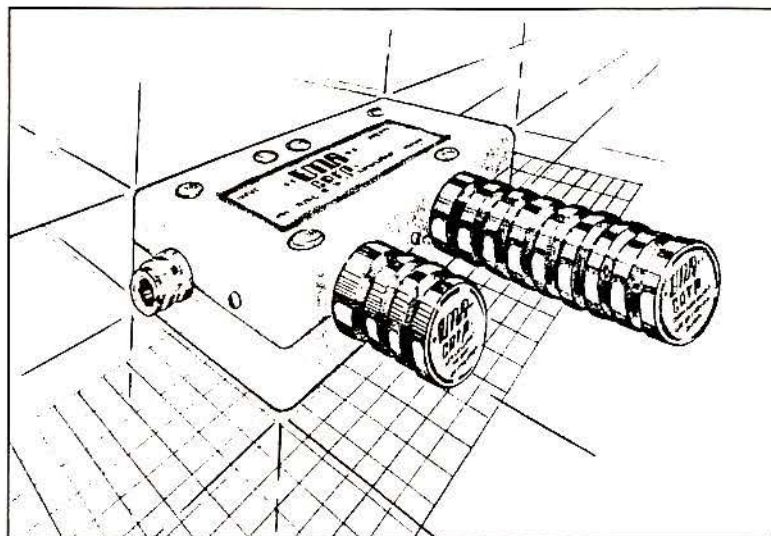
The HCC 7/8-inch Flexwell, air dielectric 50Ω coaxial cable from **Cablewave Systems** has a tubular center conductor. Its flexible transmission line has a high velocity of propagation and low attenuation. It accommodates medium-power applications at frequencies as high as 5GHz.

Circle (413) on Fast Fact Card

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Circle (73) on Fast Fact Card



## Radio modules link sub-SCADA systems

The series 2700 radio modules from **Lucas Ledex** link its sub-SCADA systems. Used in model 2504 remote station packages, the unit allows system configuration in indoor and outdoor enclosures complete with battery backup, charger, solar panel and function cards. UHF and VHF modules are available with transceiver, transmitter and receiver. Output is as much as 5A, 12Vdc operation.

Circle (235) on Fast Fact Card

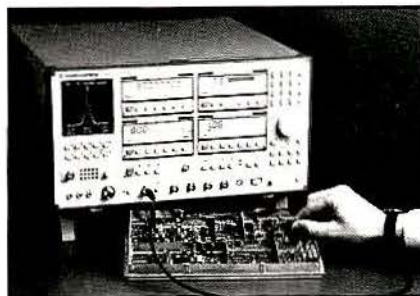
## Power sensor enables measurement accuracy



Model 6923 high-sensitivity power sensor from **Marconi Instruments** covers 10MHz to 26.5GHz and is for use with models 6950, 6960 and 6960A power meters.

Circle (338) on Fast Fact Card

## Radio analyzer includes storage scope, AF filters



The radiocommunication analyzer **CMTA** from **Rohde & Schwarz** includes standard measuring capabilities and special instruments such as RF, AF and SSB spectrum analyzer; storage oscilloscope; adjustable AF filters; continuously tunable distortion meter; and system simulators for the main cellular radio networks.

Circle (425) on Fast Fact Card

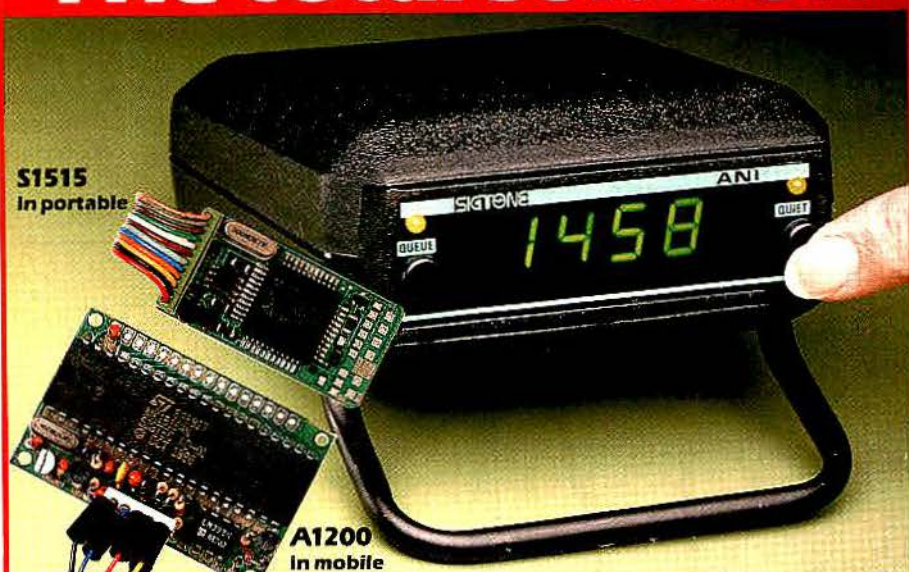
## D-size lithium battery delivers medium-rate current

The TP 5830 D-size lithium battery from **Tadiran Electronic Industries** has a shelf life of 10 years and delivers medium-rate current. The 3.6V super high-energy density battery works in temperatures of  $-67^{\circ}$  to  $+150^{\circ}$ F. The battery has been submitted for UL testing and certification. Capacity is rated at 14Ah.



Circle (204) on Fast Fact Card

# ANI- Automatic Number Identification The total solution



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This great system gets it all together with the S1515 ANI Encoder for portables, A1200 ANI Encoder for mobiles and the A1458 Identity display base unit. The A1458 queues up to 10 calls, has a time/date clock display and RS232 output for printer or computer display.

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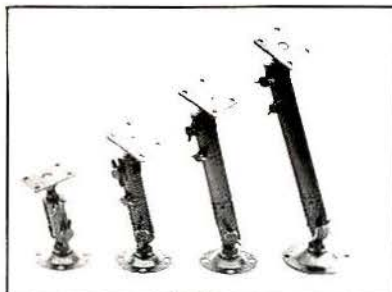
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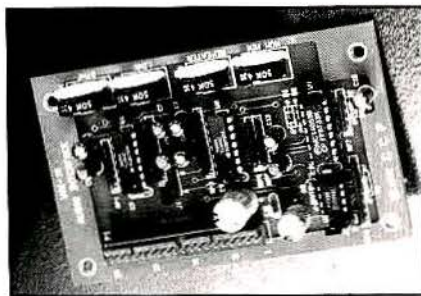
Tomball, Texas 77375

Circle (75) on Fast Fact Card

## **New products**

### **Audio interface board for repeaters is offered**

The UAI-10 universal audio interface board from **Creative Control Products** mixes repeater audio and link audio. The unit can mute DTMF tones from the repeater transmit audio. Control inputs to the board include COS, DTMF mute and an auxiliary output from the controller for the link mute function. Audio outputs include the repeater, link and a DTMF output.



Circle (407) on Fast Fact Card

### **DTMF mic fits 800MHz mobiles**

A DTMF mic for 800MHz mobiles in **Midland LMR's** Channel Management System (CMS) high-speed digital trunked systems is applicable for trunk-mount and under-dash units. Model 70-2123 features dial-out, half-duplex capability to CMS "dispatch" mobiles in interconnected systems. A six-pin mic jack kit is included.

Circle (212) on Fast Fact Card



### **NOTICE OF PRODUCT EXCHANGE**

Notice is hereby given that a number of Page-Com RT 15/C radios may have been sold which contained used and/or reconditioned parts. If you have purchased one of these radios, you are entitled to have that radio exchanged, at no cost or charge to you, for a new RT 15/C radio. Under the terms of a Court Order to which Page-Com has agreed, Page-Com is obligated to replace those radios free of charge with new radios, and to pay all associated shipping costs.

Those radios which may contain used and/or reconditioned components and are eligible for exchange are Page-Com RT 15/C radios bearing six digit serial numbers beginning with the three digits "100" (for example "100195"). The serial number is located on the label affixed to the back of the radio.

If you have purchased one of these radios and wish to exchange it, return it to Page-Com, Inc. at 10935 Adler Circle, Dallas, Texas 75238, and include an invoice showing your shipping charges. Upon receipt of the radio Page-Com will promptly ship you a new Ritron RT 15/C radio, free of charge, and will also refund your shipping costs. Page-Com's standard 6-month warranty will apply to the new radio and will commence on the date of the exchange.

The events which have necessitated this exchange are not the responsibility of the radio manufacturer, Ritron, Inc., of Carmel, Indiana.

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Circle (76) on Fast Fact Card



# Talk To The Two Old Reliables In The Industry



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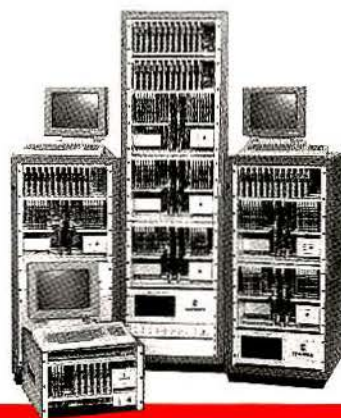
We hope you'll get good advice.

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*\*Dividends cannot be guaranteed and must be declared by Royal's Board of Directors.*





## New products

### Frequency counters cover 3 ranges



A line of frequency counters from **Goldstar Precision Company** are available in three frequency ranges with two models in each range. Models FC-7011 and FC-7012 span 1Hz to 100MHz. Models FC-7051 and FC-7052 cover through 550MHz. Models FC-7101 and FC-7102 span through 1GHz. The counters have eight-digit LED displays, high sensitivity and measured data hold functions.

Circle (398) on Fast Fact Card

### Portable transceiver provides 6W output



A 6W hand-held transceiver from **Ace Communications** spans 150MHz to 174MHz. It offers 0.3 $\mu$ V SINAD sensitivity and a 5MHz, zero degradation frequency spread. The unit comes with a 450mAh rechargeable battery, ac charger-adaptor, flexible rubber antenna, belt clip, protective case and a fast-slow rate drop charger. The portable incorporates a high-low power switch.

Circle (356) on Fast Fact Card

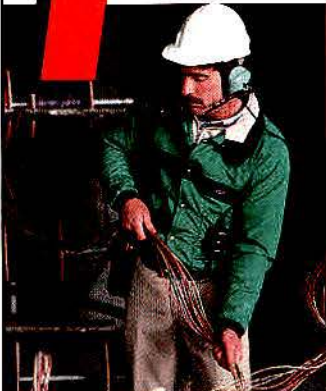
### Remote channel select fits Johnson system

The H-2125 remote channel select for E. F. Johnson 8600 series trunked system allows selection of any group and system from any DTMF telephone in user's telephone system. Made by **Hyperdyne**, the unit is used in conjunction with the F-2100 radiotelephone in-


terface unit, and it includes a programmable DTMF decoder to provide direct access to the "Ring Rack" feature of the F-2100 without requiring the normal three keyups.

Circle (431) on Fast Fact Card




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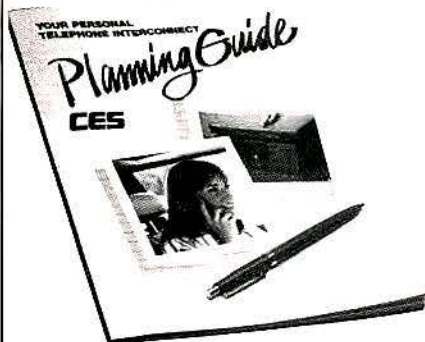
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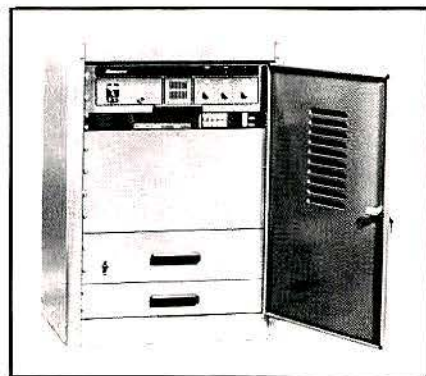
FAX: (407) 679-8110

Circle (80) on Fast Fact Card

## New products

### Base stations, repeaters offer choice of power

The BaseTech VHF base stations and repeaters from **Midland LMR** include selectable switch for direct or repeater operation and offer a choice of RF output: 45W to 70W adjustable, 100W to 150W adjustable and 250W. The units operate continuously, 24 hours a day. The transmitter adjusts automatically to safe power levels during adverse conditions. As many as four channels are standard, and as many as eight channels may be added optionally. A 12W audio amplifier is standard.



Circle (222) on Fast Fact Card

### Alphanumeric messages carried via phone lines

The ACR 1001 alpha computer remote from **Fitzgerald Telecommunications** enables alphanumeric paging messages to be transmitted over dial-up telephone lines. Features include time and date stamp, as many as nine

programmable messages to precede any alpha message, entry of as many as 15 full messages before dispatching, last-message recall and a logging directory. The unit has an LCD and standard keyboard. It weighs 1 pound.

Circle (306) on Fast Fact Card



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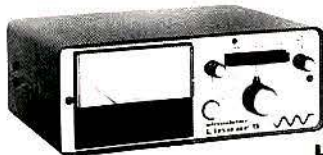
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Circle (82) on Fast Fact Card



## Buyers' source book helps service professionals

The *Buyers' Sourcebook* from **Motorola** is suited for the service professional to aid in installation and maintenance of Motorola radios. Information is broken out by individual radio models and includes accessories, service tools and manuals for particular units. The book contains five sections; two are available now with the remaining three to be available in the near future. The book covers two-way mobiles and portables, base stations and cellular telephones.

Circle (383) on Fast Fact Card

## Newsletter covers cellular topics

A four-page newsletter, "The Cellular Spectrum," from **Ora Electronics** covers cellular technology, facts and figures, merchandising tips and profitable marketing ideas.

Circle (421) on Fast Fact Card

## Catalog presents cellular mobile antennas

**Antenna Specialists'** 16-page cellular telephone and accessories catalog includes information on 40 cellular mobile antenna models. The catalog lists glass-mount, elevated feed, fiberglass marine, low-profile broadband quarterwave and cellular portable antenna types.

Circle (374) on Fast Fact Card

## Measuring equipment is focus of catalog

**Rohde & Schwarz's** "Measuring Equipment 1988" catalog includes material on spectrum analysis, EMI testing, ATE, in-circuit testing, functional testing and testing the C, NMT-450/900 and Radiocom 2000 networks. Software support for the process controller, family PCA and test system applications are included. An appendix deals with related equipment from the company's divisions.

Circle (427) on Fast Fact Card

## Brochure features RF, microwave power meters

A 10-page brochure describes features, specifications and accessories for **Marconi Instruments'** 6950 and 6960A power meters. Accessories for both power meters are listed. Two pages describe Marconi's line of 6910, 6920 and 6930 series of power sensors.

Circle (428) on Fast Fact Card

## Battery catalog lists ratings

Replacement nickel-cadmium batteries for paging, communications, public safety and other applications are detailed in a new 16-page color catalog from **JaBro Batteries**. The guide lists most popular brands and the latest models of two-way radios and pagers with cross-references for battery selection. The catalog includes voltage and capacity ratings, dimensions and charge rates, heavy-duty gel lead batteries and specialty products such as lithium memory back-up batteries.

Circle (423) on Fast Fact Card



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## Readers use magazine as product source

More than 75% of the readers responding to the July 1988 "What Do You Think?" questionnaire said *MRT* helped them with the purchase of equipment in the last 12 months. Equipment ordered spans all communications equipment categories, with the popular items including hand-helds, mobiles, repeaters, test equipment, phone patch, communications equipment for resale, radio systems, antennas, combiners-multicouplers and interconnect equipment.

Readers also commented on how they use the magazine. Perhaps some of the uses listed here are ones you could adopt, as well:

- To locate distributors of equipment.
- As a resource manual.
- For technical information, product information and product developments.
- To keep abreast of new developments.
- As a technical reference.
- To recommend improvements to our

radio technical personnel.

- To keep up with new technology and equipment.
- For purchase, new developments and uses of test equipment.
- To keep up with competition.
- To keep up with current land mobile trends.

Industry developments that respondents expressed interest in include: 900MHz SMR data and vehicle location, digital technologies, cellular repair, test equipment, unusual system licenses, grounding, interaction with broadcast transmitters, telemetry and improved modulation techniques for digital transmission.

Topics also of interest are dual-band radios, remote controls, surface-mount devices, trunking, CAD systems, computers and RF in vehicles, ACSSB and vehicle noise reduction.

**Be sure to fill out this month's "What Do You Think?" questionnaire on page 97 so your responses can be included in a future "Feedback" column.**

*"What do you think?"*

**How do you view the PCP market?**

1. The PCP market is growing rapidly. 2. The PCP market is growing slowly. 3. The PCP market is stagnant. 4. The PCP market is declining.

5. The PCP market is very competitive. 6. The PCP market is not very competitive. 7. The PCP market is highly competitive. 8. The PCP market is not highly competitive.

9. The PCP market is very profitable. 10. The PCP market is not very profitable. 11. The PCP market is highly profitable. 12. The PCP market is not highly profitable.

13. The PCP market is very risky. 14. The PCP market is not very risky. 15. The PCP market is highly risky. 16. The PCP market is not highly risky.

17. The PCP market is very stable. 18. The PCP market is not very stable. 19. The PCP market is highly stable. 20. The PCP market is not highly stable.

21. The PCP market is very volatile. 22. The PCP market is not very volatile. 23. The PCP market is highly volatile. 24. The PCP market is not highly volatile.

25. The PCP market is very predictable. 26. The PCP market is not very predictable. 27. The PCP market is highly predictable. 28. The PCP market is not highly predictable.

29. The PCP market is very unpredictable. 30. The PCP market is not very unpredictable. 31. The PCP market is highly unpredictable. 32. The PCP market is not highly unpredictable.

33. The PCP market is very consistent. 34. The PCP market is not very consistent. 35. The PCP market is highly consistent. 36. The PCP market is not highly consistent.

37. The PCP market is very inconsistent. 38. The PCP market is not very inconsistent. 39. The PCP market is highly inconsistent. 40. The PCP market is not highly inconsistent.

41. The PCP market is very reliable. 42. The PCP market is not very reliable. 43. The PCP market is highly reliable. 44. The PCP market is not highly reliable.

45. The PCP market is very unreliable. 46. The PCP market is not very unreliable. 47. The PCP market is highly unreliable. 48. The PCP market is not highly unreliable.

49. The PCP market is very accurate. 50. The PCP market is not very accurate. 51. The PCP market is highly accurate. 52. The PCP market is not highly accurate.

53. The PCP market is very inaccurate. 54. The PCP market is not very inaccurate. 55. The PCP market is highly inaccurate. 56. The PCP market is not highly inaccurate.

57. The PCP market is very precise. 58. The PCP market is not very precise. 59. The PCP market is highly precise. 60. The PCP market is not highly precise.

61. The PCP market is very imprecise. 62. The PCP market is not very imprecise. 63. The PCP market is highly imprecise. 64. The PCP market is not highly imprecise.

65. The PCP market is very detailed. 66. The PCP market is not very detailed. 67. The PCP market is highly detailed. 68. The PCP market is not highly detailed.

69. The PCP market is very undetailed. 70. The PCP market is not very undetailed. 71. The PCP market is highly undetailed. 72. The PCP market is not highly undetailed.

73. The PCP market is very thorough. 74. The PCP market is not very thorough. 75. The PCP market is highly thorough. 76. The PCP market is not highly thorough.

77. The PCP market is very unthorough. 78. The PCP market is not very unthorough. 79. The PCP market is highly unthorough. 80. The PCP market is not highly unthorough.

81. The PCP market is very complete. 82. The PCP market is not very complete. 83. The PCP market is highly complete. 84. The PCP market is not highly complete.

85. The PCP market is very incomplete. 86. The PCP market is not very incomplete. 87. The PCP market is highly incomplete. 88. The PCP market is not highly incomplete.

89. The PCP market is very organized. 90. The PCP market is not very organized. 91. The PCP market is highly organized. 92. The PCP market is not highly organized.

93. The PCP market is very disorganized. 94. The PCP market is not very disorganized. 95. The PCP market is highly disorganized. 96. The PCP market is not highly disorganized.

97. The PCP market is very professional. 98. The PCP market is not very professional. 99. The PCP market is highly professional. 100. The PCP market is not highly professional.

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## People



Wehr



Casciano



Mann



Maloun

**Eilene Wehr**, vice president of Reach Electronics, Lexington, NE, advances to president.

**Phil Casciano**, vice president of Bomar Crystal, Middlesex, NJ, leaves Bomar to form a rep firm, PMC Associates, Somerset, NJ.

**Enid Mann** of the government group of Ray Proof Shielding Systems, Norwalk, CT, advances to customer service manager for Ray Proof East.

**Garry Laird**, southern regional communications account manager for Kustom Electronics, Lenexa, KS, advances to manager of communications products. **John L. Maloun**, area sales manager for Midland International, Kansas City, MO, moves to Kustom as national voice communications account manager.

Changes at Alliance Telecommunications, Dallas, include: **James F. Jennings Jr.**, president of Meadows Resources, Albuquerque, NM, the major shareholder of Alliance, becomes Alliance chairman. **Frederick W. DeTurk**, chairman of DeTurk, Rich and Company, Stamford, CT, and director of Alliance since October 1987, advances to president of the corporation. **William O. Hunt**, who was chairman of the holding company and president of one of its four subsidiaries, Alliance Frequency Management Group, left the company because of philosophical differences at the board level.

Officers for Alliance Frequency Management Group include: **Harry Stemple** is chairman of the board. **Michael K. Morin**, executive vice president, becomes president.

Staff changes at Yaesu U.S.A., Cerritos, CA, include: **Chip Margelli**, national sales manager, advances to vice president of marketing for commercial and amateur products. **Craig Nichols** is named national sales manager for commercial and amateur products.

Three regional sales managers are named: **Mike Lysle** will handle the eastern region; **Mike Kerr** is responsible for the central region; and **Mike Henderson** will serve the western region.

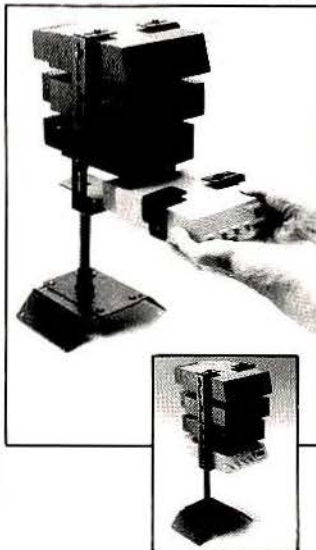
**Janet Vogel**, marketing coordinator at Maxon Electronics, Kansas City, MO, moves to Tekk, Kansas City, as office supervisor.



**Servicing the bottom radio?  
No problem.**

## StackMaster

Multiple Unit Mobile Radio Mount



- Each unit is supported independently and can be removed or installed without dismantling the stack.
- Over-the-seat mounting swivels, tilts, or shifts position for best visibility and access to controls.
- Solid, heavy-gauge frame does not require dashboard bracing, preserving vehicle resale value.

STACKMASTER fits any vehicle or complement of equipment. Two and 4-unit variations are available. Easy installation.

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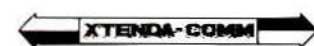
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**VERSATILE** - Compatible with most mobiles, including trunked.  
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 Step-by-step instructions included.  
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PATENTED



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- 3db gain
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- Goes Through Car Wash (no removal or adjustment)
- Whip Only 20" Long (trim to exact frequency)
- Black Chrome Electroplate Whip
- Model #OW3-450 Jr.

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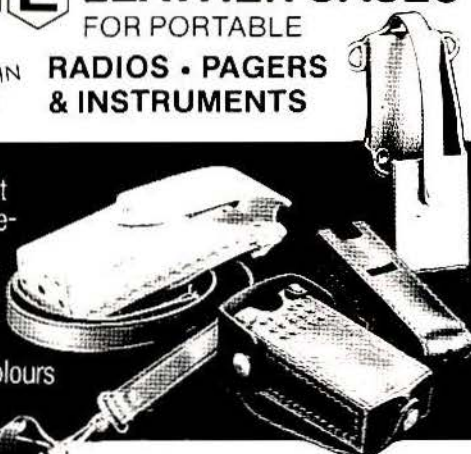
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For added protection, custom logo  
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## Calendar

### March

**15-18—National Association of Business and Educational Radio 1989 Annual Meeting**, Fairmont Hotel, New Orleans. Contact: 703-739-0300.

**19-22—Energy Telecommunications and Electrical Association '89**, Louisiana Superdome and Hyatt Regency New Orleans, New Orleans. Contact: 214-578-1900.

**21-23—Associated Public-Safety Communications Officers Gulf Coast Regional Conference**, Arlington Convention Center, Arlington, TX. Contact: 817-459-6151.

**29-31—International Mobile Communications Expo**, Las Vegas Convention Center, Las Vegas, NV. Contact: 303-220-0600.

### April

**20-22—Associated Public-Safety Communications Officers North Central Regional Conference**, Woodfield Hilton Hotel, Arlington Heights, IL. Contact: 312-774-8568.

### May

**1-3—Vehicular Technology Society of the Institute of Electrical and Electronics Engineers Conference**, Sir Francis Drake Hotel, San Francisco. Contact: Frank Thatcher, 415-956-6118.

**3-5—Telocator Spring Meeting**, Orange County Convention Center/Civic Center, Orlando, FL. Contact: 202-467-4770.

**21-25—Associated Public-Safety Communications Officers East Coast Regional Conference**, Marriott Hotel, Charleston, WV. Contact: 304-768-3732.

### June

**18-21—Utilities Telecommunications Council Annual Meeting**, Lake Buena Vista Palace, Orlando, FL. Contact: 301-621-5596.

### July

**17-19—Forestry-Conservation Communications Association**, Coeur D'Alene, ID. Contact: 208-765-1811.

### August

**6-10—Associated Public-Safety Communications Officers 55th Annual National Conference**, John Ascuaga's Nugget, Sparks, NV. Contact: 800-824-1850.

**27-30—International Association of Fire Chiefs Annual Meeting**, Indianapolis Convention Center, Indianapolis. Contact: 202-833-3420.

### September

**7-9—Land Mobile Expo/East**, Orange County Convention Center/Civic Center, Orlando, FL. Contact: 303-220-0600.





## New Ideas Just Keep Hatching!

New products like...  
The **Remote Network Controller (RNC)**. The RNC supports multiple access to the site equipment providing an early warning of impending system problems.

The **Remote Power Monitor**. For measuring voltage, temperature, RF power, switch closures and dynamic testing of transmitters.

**RadioPac II+** from C/MK Micro Solutions, used by SMRs coast to coast, is designed to increase profits by maximizing your time and effort through system management support.

Even if you are using an air-time collection device which came with **FREE** software, **RadioPac II+** should be a part of your management team.



We pride ourselves in developing reliable, innovative, state-of-the-art equipment for the land mobile industry. We specialize in trunk system products.



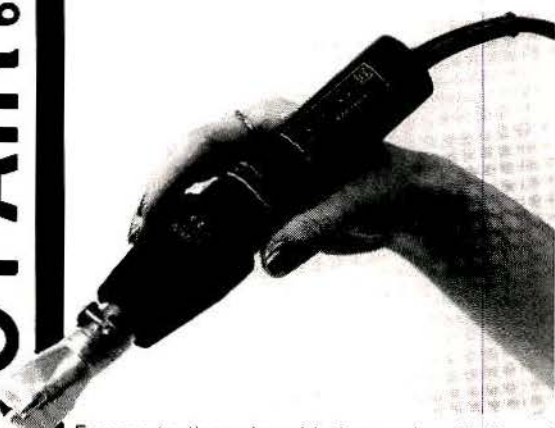
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Electronic Temperature Adjustment from 20 to 600°C. Three-way Air Volume Adjustment from 1 to 30 litres per minute.

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Ads larger than one inch are sized in 1/4-inch increments and billed accordingly, as determined by total size of the ad, including ruled borders and rounded up to the nearest 1/4-inch.

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Position for talented field/shop tech to maintain LTR sites, repair Johnson, Uniden Trunked and other LMR equipment. Must be innovative and experienced. Salary DOE and benefits. Resumes to: **Northwest Instrument**, Attn: Tim Bird, 2525 West Commodore Way, Seattle, WA 98199. (206) 284-8080.

### IMMEDIATE OPENINGS TELXON CORPORATION

Telxon, the leader in hand-held computer industry, has openings for individuals with radio communications experience. Seek R.F. Engineer, digital data trans, low power, UHF, VHF communications. Also, with radio communication experience, positions exist for Systems Analysts, Programmers, Technicians, Senior Sales Reps., and Marketing Managers. Salary commensurate with experience including benefits. Send resume and salary history to: Telxon Corporation, Dept. RF, 3330 W. Market Street, Akron, OH 44313.

EOE

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- Bonus Program

Please send resumé with salary requirements to:

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\$29,731 - \$40,105

**DUTIES:** Supervises and participates in the testing, installation and maintenance of radio, electronic and digital communications equipment.

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Apply by February 24, 1989 to: CITY OF MESA, Personnel Dept., P.O. Box 1466, Mesa Public Library Bldg., 64 E. 1st Street, 2nd Floor, West Entrance, Mesa, AZ 85211-1466.

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- All equipment totally reconditioned.
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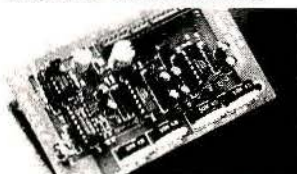
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CTCSS decoder on the UAI-20 only  
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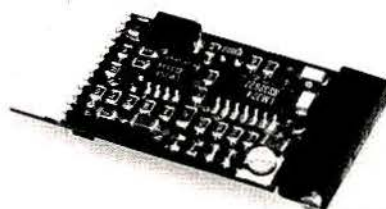
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#### Miniature Universal CTCSS Encoder/Decoder

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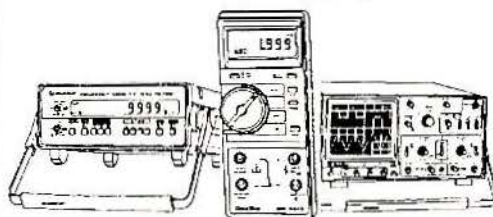
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C53RCB1105 150-162 & 162-174 60W C.D. Tone  
C53RTB3105 150-162 & 162-174 60W DC Control  
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NKX

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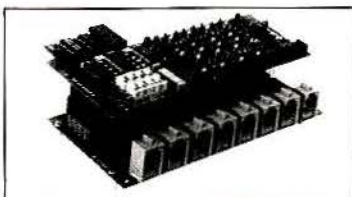
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375 GE Portables, 490-512 MHz, PE55KFWFPX  
5 MITREK, 460 MHz, T64JJA6000  
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### MCA-16 Multichannel Adapter

Permits Channel Expansion of Motorola

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Selects and/or Monitors Up to Eight Base Stations.

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Displays Station Activity and Channel Selection.



### PM-2 Digital Paging System

Cost Effectively Add Digital Formats to Existing Paging System.

Use with General Electric Master II Transmitters. For Locally and Remotely Controlled Systems.

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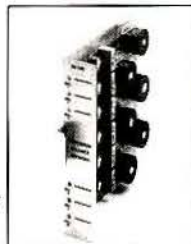


### SC-101 STATION CONTROL

- 15 Amp Power Supply
- Tone Remote Interface
- PTT, MONITOR, F1/F2
- Local Control Features
- Use With Any Mobile Radio

### BN-186 Balance Network

- 20 dB Improvement in Hybrid Balance
- Subscriber Loops Under 2000 Ft
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- Six Identical Networks Per Card



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## SHARED REPEATER PANEL



Model ST-180

### New Shared Repeater Panel

- **Compact Size**—19"L x 1.75"H x 1.0"D
- **Digitally Programmable**—To any of the 37 RS-220-A CTCSS frequencies plus 97.4 Hz.
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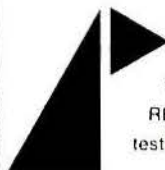
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Our new Universal Tone Encoder lends its versatility to all tastes. The menu includes all CTCSS, as well as Burst Tones, Touch Tones, and Test Tones. No counter or test equipment required to set frequency—just dial it in. While traveling, use it on your Amateur transceiver to access tone operated systems, or in your service van to check out your customers' repeaters; also, as a piece of test equipment to modulate your Service Monitor or signal generator. It can even operate off an internal nine volt battery, and is available for one day delivery, backed by our one year warranty.

**COMMUNICATIONS SPECIALISTS**

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TE-64 \$79.95